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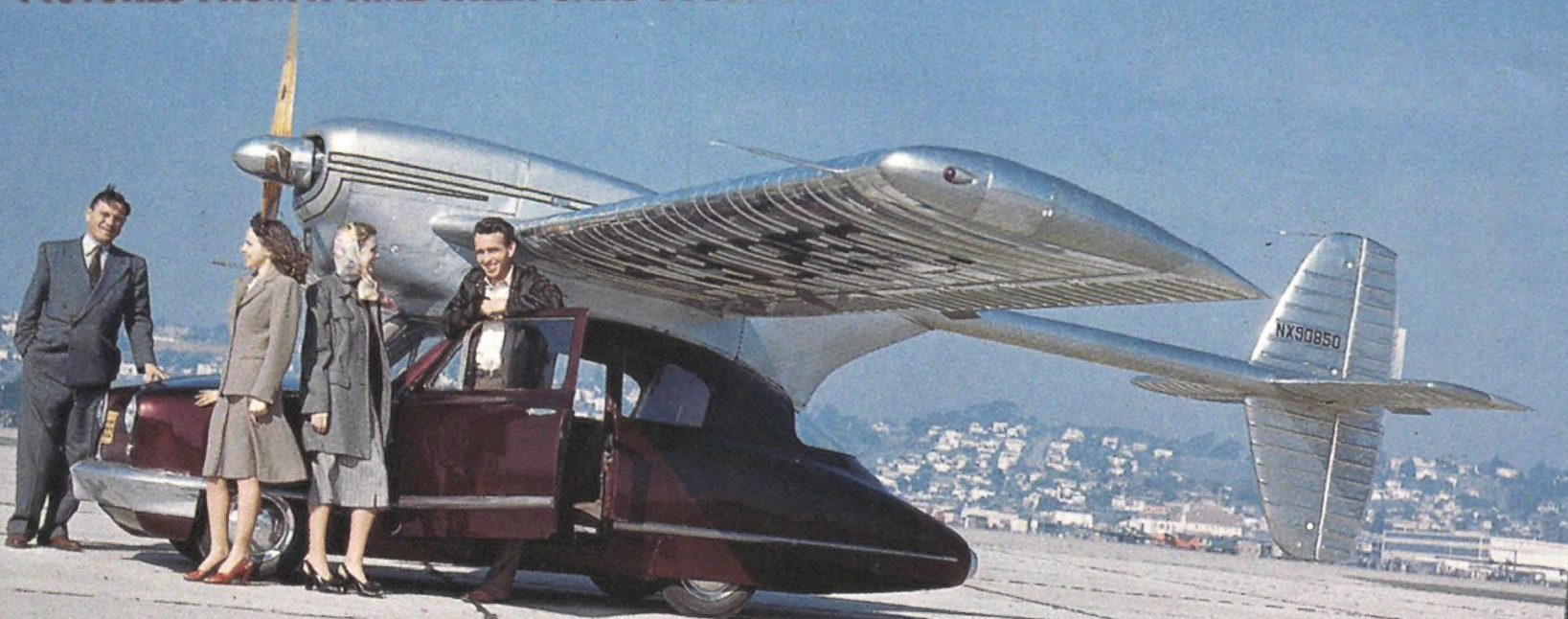
# AIR & SPACE

Smithsonian

SEPTEMBER 2000

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Smithsonian

August/September 2000

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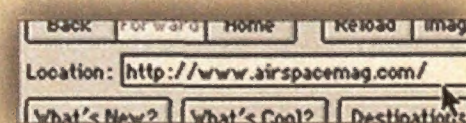
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**Cover:**  
The year was 1948, the spirit was can-do, and the photographer who took this picture of Convair's Flying Auto in California was the masterful Ben Ross.





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# BREITLING

1884



## Beginning to Begin

**D**eputy Director Don Lopez and I took a trip down to the Kennedy Space Center in Florida in June for a meeting of our National Air and Space Museum board of directors. As we took off from Dulles International Airport, we flew right past the site of the new Steven Udvar-Hazy Center—the extension that will supplement the museum on the mall—and we could look down and see the work under way. Construction has actually begun, and it's a great feeling to see the activity that we have all been awaiting for so long. The Commonwealth of Virginia is providing the site preparation, which includes the construction road, walkways, a taxiway, the perimeter fence, a parking lot that will hold 2,000 cars, the utilities up to the building, and finally an interchange at Route 28 in Chantilly, which will be the entrance to the Center.

That's the good news. The other news is that we are only halfway to our goal in raising funds. We still need \$95 million to fully fund the construction of the Center. This brings a sense of urgency to our campaign, and we are fully mobilized to accomplish our mission. All of you have received requests from us to support our new facility, and you have responded magnificently, in both donations and spirit.

If you have been thinking about increasing your contribution, this would be a great time to do it. We have a schedule of construction milestones, each of which will require a payment in order to continue on to the next milestone. Now it is up to us to fund each step of the process.

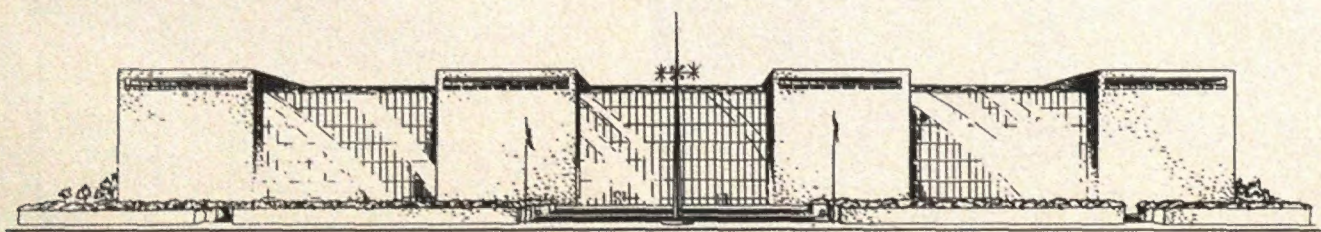
Those of you in the construction business may wonder why we are

beginning the project without all funds in hand and assuming that the funding will arrive in time to keep the construction moving. The answer lies in the other charter of the fund-raising mission, which is to complete the project not later than December 17, 2003, the centennial of the Wright brothers' first powered flight. The plan that former NASM director Don Engen fostered is to have the Museum open as a centerpiece of the centennial celebration. To open the doors in time, we had to begin construction last June.

As you can see, we have our work cut out for us. One thing that has become clear is that we haven't gotten the word out to everyone who needs to know. That's where you can perform a great service. Each of you is a valuable member of the team. In addition to making your own contributions, you can pass the word to others who will want to support this project but don't know how. The 12-page special section that we have provided in this issue outlines the plan and how to support the effort. We have an incredible opportunity to finally get the majority of our collection on display for public view, but we need your help to make it happen. If each of you will inform others about what we are trying to do and why, it could make a big difference.

Getting the word out is a key element to the completion of our mission. It's time to push the throttle up to 105 percent and see how fast this machine will go. Please do what you can to help build the Udvar-Hazy Center.

—J.R. Dailey is the director of the National Air and Space Museum.



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Editorial: (202) 287-3733 • fax: (202) 287-3163  
e-mail: editors@airspacemag.com

Advertising: (415) 454-9782 • fax: (415) 454-9785  
e-mail: airspacemag@marinternet.com

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## LETTERS

### The Remembered War

Although not a naval aviator, I remember well the incident of the *Oriskany* F9Fs engaging the MiG-15s coming out of Vladivostok ("Jet Meets Carrier," June/July 2000). My ship, the USS *Helena*, and a single escorting destroyer had front row seats. We were close to the border of North Korea and Russia at the time. Our duty was to use our helicopter to rescue crews ditching from U.N. planes that got damaged while conducting a large combined air strike on North Korean targets. Believe me, we were rooting for and very appreciative of the *Oriskany* pilots—at that stage of the Korean war, the anti-aircraft fire control systems aboard Navy surface ships were World War II vintage, and were not capable of defending against jet aircraft. I am thankful that the *Oriskany* guys did their job so well. The outcome of that incident apparently discouraged further air attacks against surface ships during the remainder of the war.

—Bill Graf  
Dallas, Texas

I think you concentrated too much on the air-to-air role of the planes in Korea, and the large air drops conducted during the early days, forgetting to mention some of the planes and pilots that gave the infantry on the ground excellent support (Korean War Album, June/July 2000). From July 1952 until the truce was signed in 1953, I was a 75-mm recoil-less gunner and later a radio mechanic. I was at Old Baldy, Arrow Head ridge, and in a blocking position at White Horse mountain when the Chinese made a big push later on. What I remember most of the air support I witnessed was the South Africans flying the "obsolete" P-47 Thunderbolt. They and the Navy/Marine pilots would come right down on the

deck, using both guns and rockets, and finishing with a low altitude bomb or napalm drop. Dropping napalm from 5,000 feet and higher, as the Air Force did, makes a very pretty splash, but for accuracy you have to put it where the targets are, and that means staring into their eyeballs, and that's what these pilots did. I recall seeing several Navy planes, at the end of a firing pass deep into a valley, lay their napalm uphill as they started to climb out. I never saw any anti-aircraft artillery fired at the high Air Force bomb runs, but neither did I see a Navy, Marine, or South African pilot who didn't face it. We theorized that the Chinese philosophy was "Don't waste ammo on what can't hurt you."

—Charles Fox  
via the Internet

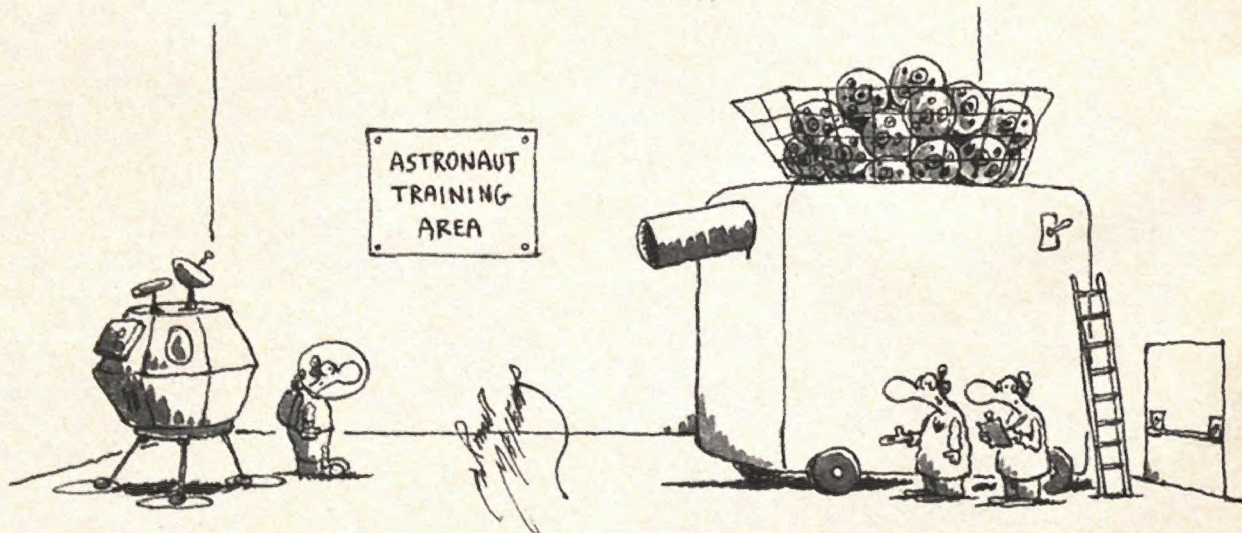
The C-119's engines were indeed 3,500 horsepower, but they were R-3350s ("Breakout from Chosin," June/July 2000). The latter was a turbo-compound, two-row, 18-cylinder engine. The R-4360 is a four-row, 28-cylinder engine. I was a mechanic on these beasts for six years with the 434th Troop Carrier Wing.

—Don Clapp  
via the Internet

*Editors' reply: It's true that later C-119s would be equipped with the Wright R-3350, but the B and C models had Pratt & Whitney R-4360s.*

### Hubble for Sale—Cheap!

"Light and Magic" (June/July 2000) pointed out that the Very Large Telescope's capabilities exceed that of the Hubble Space Telescope. Is Hubble then obsolete, or does it have its own advantages? Also, reading about the VLT being situated in the desert brought to



"Are you ready for the meteor shower simulation?"



mind the desert here in the Phoenix area, where we get tremendous amounts of dust. What keeps the VLT mirrors from getting dirty and how does the facility clean them?

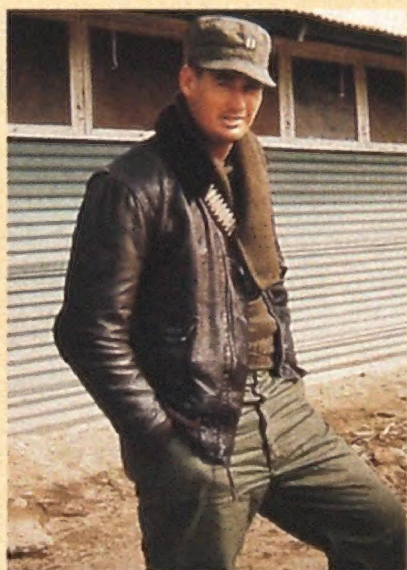
—Jay Edmiston  
Mesa, Arizona

*Eric Adams replies: The VLT's capabilities do not render the Hubble obsolete, nor do they render any of the dozens of other exceptional ground-based telescopes obsolete. Because the VLT is more powerful, it will simply conduct a different type of*

## A Legend Drops In

I was very interested to see on your Web site the mention of baseball great Ted Williams' service during the Korean War. In February 1953 I had an encounter with him while I was a pilot serving with the 36th Fighter Squadron at Suwon Air Base. I had flown 72 combat missions in the F-80C and was staying on to cover some extra duties while the other pilots were trained in F-86s.

On February 16, I was monitoring returning missions with the base operations officer from the mid-point of our 10,000-foot-long runway. We had a radio to monitor tower frequency and could talk to the tower. At one point, we heard some Marine Panther pilots radio the tower that one of their people had been hit, had no radio, and was in trouble. Soon we saw a Panther cross over the runway from east to west at about 1,000 feet. It was streaming some kind of vapor or fluid, and as it reached the far side of the runway and the 51st Wing area, a panel or some other part dropped off. The Panther turned downwind, and smoke and fire could be seen out the rear of the bird. The aircraft touched down well down the runway, and as it approached our position we saw that it was skidding on its belly, still trailing smoke and beginning a slew to the right. We ducked as it passed us, since we didn't like the idea of those machine guns possibly cooking off! As the Panther continued down the runway and slid off into to dirt, we followed and called for the crash crew.



ROBERT VEAZEY

The Panther came to a halt and, within a minute or two, the ops officer and I approached the bird as the pilot was exiting the cockpit. We helped him off the wing and took him into our vehicle. The crash crew arrived and started putting out the fire that had started eating at the aft end of the aircraft.

We took the Marine to the base hospital for a checkup, where we found out that he was Ted Williams. When the hospital released him, we took him to base ops, where some fellow Marine pilots awaited him. I had about 45 minutes or so with Williams, and we discussed how he happened to be recalled to duty. He posed for a couple of pictures (above), and by this time the GIs had the word that he was there, and he graciously posed for more pictures and signed a few autographs. Then a Marine R4D aircraft had arrived and we took him down to the flightline and said goodbye. Williams did a great job getting that Panther down, and all who witnessed the event agreed.

—Robert Veazey  
via the Internet

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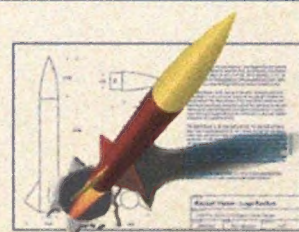
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*program than the Hubble and the other observatories. The Hubble—with its steady aim and powerful instrumentation—remains a key element in the study of deep-space objects and galactic evolution, but for studies that require deeper penetration into the universe's past, the VLT is hard to beat.*

*Though the VLT's mirrors are shielded during the day and as much as possible at night, they do accumulate a fair amount of dust. You can see it if you look at the surface of one from the edge. But the accumulation is slow enough that it doesn't affect the mirror's performance for some time. The mirrors are cleaned as part of their regular maintenance cycle: They will be removed every one to two years, transported down the mountain to the mirror maintenance facility, and cleaned and recoated. The process takes only a few days.*

### Look, Ma, No Afterburners!

You referred to the Concorde as "cruising on afterburner at Mach 2" ("Ahead of their Time," Apr./May 2000). The decision to power the Concorde with Rolls-Royce/Bristol Olympus turbojets, as opposed to the more modern turbofans, was made so that the craft could cruise at Mach 2 without the use of afterburners. The afterburners are used only for takeoff and acceleration to

transonic speeds. Thereafter, Mach 2 is sustained using "dry thrust" only. When the Russian Tupolev 144 ("Concordski") first appeared, some misguided Western observers commented that its use of turbofan power made it more sophisticated than the Concorde. But they were wrong: The Tu-144 was only able to sustain Mach 2 by continuous use of afterburners, leading to very high fuel consumption and severely reduced range. We have to move forward some 30 years to find a plane capable of sustained supersonic speed using turbofans in dry thrust mode: the current Lockheed F-22 fighter, with "supercruise" engines.

—Geoffrey Gunning  
Indian Shores, Florida

### Weirding Language

I realize that it is common for writers to use the jargon of the subject group in an effort to make the writing seem more intimate ("The Truth Is Down Here," June/July 2000), but "ground truthing"? Barf. Remember what Calvin told Hobbes: "Verbing weirds language."

—P. Michael Bowden  
La Vergne, Tennessee

### Fine-Tuning the DC-3

In answer to Dale D. Holcomb's roasting of the DC-3 (Letters, June/July 2000), I say: Bite your tongue and wash out your

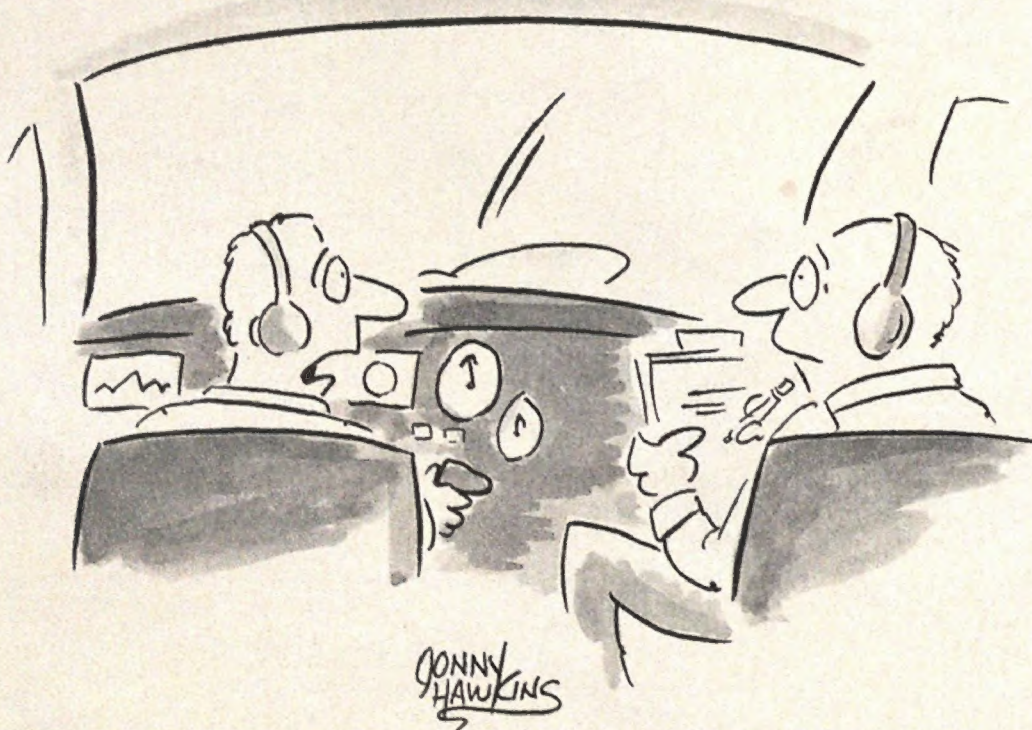
mouth with soap! To desecrate the image of this meritorious warrior by frivolously referring to her as a "junker" is a slander against all of us who have lived with and loved the honored "Gooney." As for the de-icer boots, they did exactly what they were designed to do—de-ice the leading edges after a reasonable amount of ice accretion. As far as being a handful in a thunderstorm and terrible to land—I'd be interested to see Holcomb's DC-3 flying credentials. In thousands of hours flying this beauty, I've never had cause to curse her. Under the worst situations, landings were a cinch in this stable machine. Also, I've never had to open a window to taxi, even during severe Arctic conditions.

—Leslie W. Reid  
Royal Canadian Air Force  
Air Transport Command (ret.)  
Walhonding, Ohio

Leslie E. Veit talked about being in England during World War II as a crew member on a civilian DC-3 airliner that the Army bought and retrofitted (Letters, June/July 2000). Veit was surprised that "the former DC-3 had 80,000 hours on it." I'd be surprised too. According to The Aviation Group Web site ([www.aviation-history.com](http://www.aviation-history.com)), the first prototype DC-3 flew on December 17, 1935, and the first production model entered commercial service the following June. If Veit got to England late in the war, the DC-3 he referred to would have had to be in the air for a solid nine years and three months. No wonder the DC-3 is considered so durable.

—Tom Hegele  
Cary, North Carolina

### THE MOST OFTEN ASKED QUESTION DURING A FLIGHT EXAM



"Can I use a lifeline and call a friend?"

I was most pleased to read "High Mileage" (Apr./May 2000). I flew the C-47 version of the DC-3 in China for the Flying Tigers in 1944 and '45. It was a great plane to fly. I lost two of them in China and they told us that they cost \$90,000. (Thank goodness I didn't have to pay for them!) But the article left me with one question. I believed that the first two numbers on the rudder of the C-47 was the year of manufacture—e.g. 42- meant 1942. Yet the author refers to 42-93518 as rolling off the assembly line in 1944. Is my information wrong?

—John Dickerson  
Pennington, New Jersey

*Editors' reply: You're correct that originally, the first two digits did mean the year (however, always the year of procurement—not necessarily the year*



## LETTERS

of manufacture). So even though 42-93518 was paid for in 1942, it wasn't finished until 1944—not unheard of in aircraft programs involving large orders, like the C-47. And by the way, the first two numbers haven't always meant the year of procurement. Starting in January 1942, the first digit and hyphen of serials were deleted when painted on aircraft, so "42-1234" became simply "21234" on the tail. (At the time no one thought that these aircraft would continue in service into the next decade. Specifically, no one dreamed that C-47s would have the longevity they did. In the 1950s, a zero was added to the serials of aircraft more than 10 years old.) So serial 42-93518 should have originally appeared as 293518 on that C-47's tail.

### Not So Fast

When Adele Conover refers to flight speed by body lengths, she states that "humans positively trudge at three to four body lengths per second" ("Birds Do It Better," June/July 2000). The movement of birds, cheetahs, and

Lockheed SR-71s through the air can be described by their body lengths, but we humans walk or run through the air by body widths. We swim by body lengths. If you consider that a human is six feet tall, that would be 18 to 24 feet per second. If you move a person through the air by body width, this would correlate to 18 to 24 body widths per second. This would put us in the same body width movement as the cheetah, at 18. Now, if we were compared to fish, then body length would be the proper measurement.

—Calvin A. Staffrod  
Los Gatos, California

### Corrections

June/July 2000 Reviews & Previews, "The Arrow, Revealed": The CF-105 Arrow was a product of Avro Canada, not de Havilland, which acquired Avro Canada several months after the Arrow program was canceled.

Write to us at: Letters, Air & Space/  
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# Republic, For Which It Stands

NANCY EPSTEIN



One of the monoliths in aviation in the 1930s, Republic Aviation was once planted on New York's Long Island like a defensive fortification. Today the name remains in the old factory airport in Farmingdale, now the third busiest airfield in New York State. And the physical remains of Republic—mostly a hangar and a red-brick control tower—opened as the American Airpower Museum last Memorial Day weekend.

In the 1940s the company churned out more than 9,000 of the 15,000 indestructible P-47 Thunderbolts of World War II fame. Afterward, Republic built F-84 Thunderjets, F-105 Thunderchiefs, civilian Seabee amphibians, and A-10 Thunderbolt IIs before economics shut down the factory in 1987. It sat empty for years. Following a rash of arson fires (nine in 1994 alone), developers paved a prophead's paradise

and put up a parking lot—and other mall accouterments.

Enter Jeff Clyman, aviation enthusiast and CEO of Avirex, a line of clothing embraced by the hip-hop crowd. "They were going to be flattened," says Clyman of the remaining buildings, "like there was nothing here." With a quarter-million-dollar grant from the New York state government, Clyman and his posse set up shop, moving in his sizeable collection of airworthy warbirds (including a Curtiss P-40, Grumman TBM Avenger, North American B-25, and—natch—P-47) and flight gear. They also built a replica canteen, briefing room, and ready room.

On hand for the opening were Francis Gabreski, who downed 28 German aircraft in a P-47, fellow Long Islander Josephine Rachiele, who in 1943 was riveting T-bolts for 60 cents an hour, members of the 533rd Living History

Squadron—reenactors in period garb—and a number of World War II veterans.

"I was in the war for three years and I never flew any combat—they were saving me for the invasion of Japan," says Bill McLean, a 76-year-old B-24 waist gunner who's finding his docent legs at the new museum. "I was always in training. You took the crap because you wanted to fly so bad. And there was this feeling that it was never going to end—this was your life."

Restoration work continues on the tower; when it's finished, one floor will be devoted to the company that started it all. "Republic kind of threw stuff out as they were going out the door," says museum spokesman Gary Lewin. "There's very little left in the way of substantive Republic archives." The American Airpower Museum hopes to make amends for that.

—Phil Scott





## Monster Engine Makeover

Last May, the Walter P. Chrysler Museum in Auburn Hills, Michigan, unveiled its jewel-like restoration of an XI-2220 aircraft engine ("Monster Engines," Dec. 1997/Jan. 1998), which Chrysler developed for the U.S. Army during World War II. At a media briefing, DaimlerChrysler senior vice president Bernard I. Robertson acknowledged the assistance of National Air and Space Museum curators in finding the engine, which surfaced in a private collection in Newbury, Ohio, and in its restoration. The XI-2220 is now a permanent part of the collection at the Chrysler Museum. A tank engine based on a cluster of automobile engines with a common output shaft has also been restored for display.

Between World Wars I and II, development of liquid-cooled engine technology was largely centered in Europe as the U.S. aviation industry turned to light and efficient air-cooled radials from Wright and Pratt & Whitney. Radials powered the growing airline market. Only Allison among the U.S. engine manufacturers still developed and produced liquid-cooled engines, and their only application was in military aircraft.

The XI-2220 arose from an urgent need to catch up in the aero engine technology race, particularly when it became obvious war would soon involve U.S. forces. Chrysler won a contract in 1941 to develop an advanced high-performance engine, and the resulting design was unique. The 16-cylinder XI-2220 can be thought of as a pair of inverted V-8 engines joined together to a center drive output, or T drive. Engineers' notes indicate it had a potential power output of as much as 2,500 horsepower, given sufficient boost from a supercharger.

The engine has a displacement—the total volume of its cylinders—of 2,219 cubic inches, and it measures almost 10 and a half feet in length—more than the distance from the gym floor to the basketball hoop. Just sitting on its stand it looks as long as a locomotive, and

when it was installed on its test bed, a Republic XP-47H airframe, the result was a Heckyl-and-Jeckyl-type beak. The XI-2220 also featured Chrysler's first hemispherical head combustion chamber, predecessor of the famous Chrysler Hemi engines that drove the company's line of muscle cars during the 1960s and '70s.

The XI-2220 made a number of flights on its test bed airframe, which was a curious choice in the first place. Not surprisingly, performance was thought to be not much of an improvement over the R-2800 radial, which powered the standard P-47. The contract was canceled and the war ended before the engine could be used.

For museum hours and admission fees, call (888) 456-1924 or go to [www.chryslerheritage.com](http://www.chryslerheritage.com).

—George C. Larson

## A Van for All Seasons

A prototype of the International Space Station's lifeboat is set for an automated test flight from an orbiting shuttle in March 2002. The X-38 crew-return vehicle is twice as roomy as the three-seat Russian Soyuz capsule now designated for astronaut rescue. It will glide from orbit unpowered like the space shuttle, pop a steerable parafoil for its final descent, and touch down on skids (see "Lifeboat," Aug./Sept. 1998).

Although the real crew-return vehicle will have enough support equipment to keep seven passengers alive for nine hours, no one's likely to deorbit in it before its first emergency use. So the big question is: What will it fly like?

Like a 1998 Ford Club Wagon. That's what the X-38 team at the Johnson Space Center in Houston is using to familiarize astronauts with the sensations of piloting the crew-return vehicle. They've outfitted the 15-passenger van with a Global Positioning System antenna, avionics racks for flight computers, a remote-controlled video camera, and wireless headsets. The back has room for two supine riders to manipulate two types of hand controllers. Tinted windows make it dark—the crew-return vehicle won't have windows.

Through headsets, the riders speak with the driver as they "fly" a parafoil to touchdown at Edwards Air Force Base in California. Computers display animation, GPS satellite imagery, and live or recorded mission audio and video of the landing area to give



A new exhibit, "The Avro Arrow: A Dream Denied," opened at the West Parry Sound District Museum in Ontario, Canada, last July ("Fallen Arrow," Apr./May 1998). The exhibit will travel to some 20 facilities throughout Canada over two years after closing in Parry Sound on September 10. "The Arrow is such an important part of the country's heritage that we want to dispel mythologies about the project, its development and testing, and most importantly its cancellation and destruction," says museum director Doris Muckenheim.

One factoid that recently came to light was that Arrow test pilot Jan Zurakowski never held a pilot's license. "He just never got around to it," Muckenheim says. "He achieved a high level of success as a test pilot and nobody asked him for verification of his qualifications. He also said that the only purpose of a license was to give the higher-ups something to take away for bad behavior, like dangerous flying. He was a more serious pilot because he didn't want to draw attention to himself."

the appearance of flight. When they want to steer the parafoil, the riders move the hand controls. An electronic pointer on the dashboard tells the driver when and where to turn the van in response to riders' inputs.

City streets are off limits, so the van usually heads for a spacious, empty parking lot—aiming for potholes and

grassy medians to create "virtual turbulence."

"This is a crude approximation of what it would be like to fly," says the flight test engineer and driver, Jeff Fox. "But the funny thing is," adds X-38 project chief John Muratore, "it's moving at about the same speed as you'd move under one of those parafoils. That's what makes this a valid training environment. You can get away with a little slop and still have a realistic simulation."





The vehicle is in its second incarnation. The first was as a junkyard hippie van, complete with shag carpet. The decor was the least of the concerns for project engineers, who used a handheld video camera and a briefcase-size projector to display images on white paper taped to the ceiling. It proved the concept. After that, the team spent \$5,000 on what it calls a "rapid prototype." The money paid for customizing small, off-the-shelf equipment. All the major hardware—including the van—was borrowed from various directorates at the space center.

The "Vomit Van" logo on the door—a reference to NASA's KC-135 microgravity aircraft, the Vomit Comet—with its icky green face is fair warning that even a short jaunt will jumble your gyros. Lying prone, with no horizon, in a dark room that is jouncing around is about as pleasant as being stuck belowdecks on a ship. Barf bags are tucked beside each of the uncomfortable plywood couches in the back. One of the primary objectives of the simulator is to discover how an astronaut deconditioned by several months in weightlessness might react to flying prone with a TV camera as a periscope—a scenario that has the X-38 designers worried. The X-38's seat belts are straight out of *A Clockwork Orange*—including a forehead strap to prevent neck injuries during deorbit and chute deployment. What about that nausea factor? "We're brainstorming that," says Fox, "because the worst thing you want to do is be on your back" if you're about to be ill.

The designers are using the van to experiment with different body positions and display techniques to reduce motion sickness. It is also used as a remote cockpit to control the parafoil flight of unmanned prototypes dropped from a B-52 at Edwards.

—Beth Dickey

## DEPARTURES

Daniel Heligoin and Montaine Mallet, who as the French Connection had been stars on the airshow circuit for two decades ("Now Playing at an Airport Near You," Apr./May 1993), were killed last May 27 when their CAP 10B airplanes collided during the filming of a promotional video at Flagler County Airport in Bunnell, Florida. The airshow community mourned the loss of the husband-wife team at a June 6 memorial service at the airport. Relatives will decide the future of the couple's aerobatic school.

## Great Balls of Fire

As you read this sentence, about 300 collisions between stars are occurring somewhere in the universe. Be thankful they're not in our neighborhood. If our sun ran into a comparable star, the two bodies would distend, becoming football-shaped as they gravitationally distorted each other. "They would orbit each other once or twice," says Michael Shara. "As they got closer and closer, their envelopes would overlap, and then their cores would plunge into each other. The sun would probably become 100 to 1,000 times brighter. It would boil the oceans." Shara knows his stellar collisions. At Manhattan's American Museum of Natural History, he chairs the astrophysics department, recently

established in conjunction with the museum's new Rose Center for Earth and Space.

Collisions can tell astronomers and astrophysicists a lot about stellar behavior, so last spring the Rose Center hosted the first conference on this once-obscure topic. The sessions were heated at times, as researchers squared off over one another's findings and methodologies. "This is cutting-edge science," one participant later explained, "so there's bound to be controversy."

In 1928 it was estimated that no more than 10 or 100 collisions would occur in the entire history of the Milky Way, or only about one encounter every billion years. Scientists have since determined that's the rate only for the sparsely populated region around our solar



In the early 1900s, just before the Russian Revolution, Czar Nicholas II built bases for his fleet of Il'ya Muromets heavy bombers, the mammoth Sikorsky long-range aircraft with 102-foot wingspans.

Three connected hangars—the first large concrete shell structures in the world—were completed at the Peter the Great naval base in Tallinn, Estonia, in 1917. After Estonia gained its independence in 1920, the hangars sheltered the country's air fleet. Then Estonia was annexed by the Soviets, and the hangars became merely a local curiosity. Over time they were largely forgotten. Today the naval base is a junkyard and the hangars are scrap-metal warehouses.

When the Iron Curtain came down, the hangars were in a sense rediscovered. Two years ago Danish architect Morten Lund finally got inside the structure. "When you're standing indoors, it looks like a starry sky—the sun shines through all the small holes where the concrete has fallen down," he says. "It's a very strong site. It feels like a cathedral."

Lund has been marshalling an international team of architects, engineers, and contractors—who feel it's important to preserve industrial monuments—to explore the feasibility of renovating the 344- by 115-foot structure as a national monument. First, however, a court will decide if the structure will be taken over by the Estonian government or if Russia can still claim ownership and can sell the hangars. The next step will be to find a profitable use for them without destroying their historical value.

—Jerome Rosen



## CVR Play Wins Big

Last May, the drama "Charlie Victor Romeo," which was based on transcripts from the cockpit voice recorders of six airline accidents and which played to sold-out audiences in Manhattan ("Now Playing: The Way Things Go Wrong," Soundings, Feb./Mar. 2000), won two Drama Desk awards for Sound and Unique Theatrical Experience.

system. But elsewhere in the galaxy, in globular clusters where the star density is a million times greater, the smashups are more frequent.

The problem is that while there's general consensus that collisions occur, they're very distant or very rare, so no one peering through an optical telescope has seen one. Observers base their conclusions on effects they can observe. "We're after a sort of Holy Grail," said Villanova University's Rex Saffer, which he defined as an object that "must have been formed by a collision and no other process." He thinks he may have found it.

Big, massive stars tend to exhaust their fuel and die faster than others do. "Blue stragglers" are unusual survivors that appear hotter and more massive than neighbors of about the same age. What can explain their renewed lease on life? Collisions combining the contents of two stars. In the center of one cluster, Saffer has identified five massive blue stragglers—one is so massive that it must have resulted from the merger of three stars.

Alison Sills of Ohio State University is studying star-population characteristics that suggest the occurrence of collisions. When stars collide, they generate gravitational waves, like ripples on the surface of a pond, and these waves are about to be analyzed at several observatories, reports Vicky Kalogera of the Harvard-Smithsonian Center for Astrophysics.

Even without seeing them, researchers can now simulate stellar collisions, thanks to supercomputers. Piet Hut of the Institute for Advanced Study in Princeton, New Jersey, worked with a team in Tokyo to "put the Newtonian laws of gravity on a chip." The result is the GRAPE series of special-purpose computers. GRAPE stands for "gravity pipeline"; these computers calculate the gravitational forces between pairs of stars. By next year, says Hut, the GRAPE 6 will be more than 10 times faster than any other computer. "It will be able to do only one thing, but it will do it faster than anybody

else can do anything," he says. "And it happens to be our thing."

The centerpiece of the museum's Rose Center is an 87-foot sphere that contains the new Hayden Planetarium. That virtual-reality simulator can be used for research as well as public shows. For two weeks, after the crowds had left for the evening, Hut and his colleagues would project star clusters on the dome. "Using a joystick, we'd fly through it," he said. "We'd see how collisions take place and in what circumstances. We could do it in slow motion, like a sports event in the sky."

The conference included simulations of collisions. In one case, a small, high-density star burrowed into the core of a larger target. Coded with different colors, the contents of two colliding stars swirled together, like layers in a jelly roll. Long tails flowed behind. When two high-energy neutron stars merged, they gave off showers of neutrinos, pictured in red, yellow, and green. "My own comment is that these events are too beautiful not to exist," said Shara.

—Lester A. Reingold

## Hubble's Beauty Shots

Astronomers have long seen the Hubble Space Telescope's images as treasures of science. But many others—indeed, most of the public—value the images as much for their beauty.

Recognizing this unique juxtaposition of art and science, the International Center of Photography in New York City recently awarded the Hubble Heritage Program its 16th Annual Infinity Award for Applied Photography, which encompasses architectural, fashion, and scientific photography. The year-and-a-half-old Heritage program, which every month posts on the Internet images from the orbiting observatory's visible-light camera, was recognized for valuing "both scientific information and aesthetic presence" in producing celestial photographs.

The Hubble team, which is based at the Space Telescope Science Institute in Baltimore, Maryland, is thrilled by the recognition of the project's dual purpose. "We want the end products to be both

beautiful images and research papers," says Hubble Heritage Program scientist Keith Noll.

Check the Heritage program online at <http://heritage.stsci.edu>, where a new image is posted on the first Thursday of every month. You might also catch the Smithsonian's new traveling exhibition, "Hubble Space Telescope: New Views of the Universe." The exhibition includes video, artifacts, and vivid Hubble images, and teaches visitors about the telescope's design and purpose as well as the planets, stars, and galaxies it has studied.

The initial itinerary:

Adler Planetarium, Chicago, IL; through September 5, 2000

Space Center Houston, Houston, TX; October 7, 2000–January 2, 2001

North Carolina State Museum of Natural Science; Raleigh, NC, June 2–August 26, 2001

American Museum of Natural History, New York, NY; February 2–August 25, 2002

More sites will be added (check [www.si.edu/sites](http://www.si.edu/sites) for updates), and a second version of the exhibit, designed for smaller facilities, will be launched at the Castle Museum in Saginaw, Michigan, on August 12, 2000.

—Eric Adams



STSCI/AURA, NASA

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# The Last Satellite

If the world of communications satellites could ever be the subject of a Hollywood movie, Iridium might be the inspiration. The global satellite telephone company's history unfolds like a larger-than-life script: big ideas, big money, boundless optimism, clever achievements, and then...heartbreak and finally collapse (just this March).

A few years ago, as the National Air and Space Museum's curator of communications satellites, I sought to bring Iridium's story to the Museum, not then knowing how it would unfold. Today, a Motorola-built satellite for the Iridium system hangs in our Beyond the Limits gallery, an example of Iridium's initial success—and of the opportunities and challenges of collecting “history in the making.”

In an era of rapid-fire changes in communications, Iridium stood out. In 1988, Motorola engineers Ken Peterson, Raymond Leopold, and Bary Bertiger came up with the Iridium plan: a digital, wireless telephone and paging service that would cover the entire Earth, a feat made possible by a constellation of 66 satellites in low Earth orbit. The service would be a first: No one had used low Earth orbits for a communications system before. As a supra-national enterprise, Iridium had its own telephone country code—like the United States or China—and had to overcome the technical and bureaucratic hurdles of meshing its system with phone networks around the world.

But Iridium was more than the sum of its technical and business parts. In the post-Berlin Wall era, the company symbolized the role of communications in transcending national borders and connecting people around the world. Through satellites and the Internet, new streams of information ran through and over national boundaries. Whether individual nations welcomed it or not, the global village was at hand.

In November 1998, after much hard work, many innovations, and the expenditure of billions of dollars, Iridium

started service. The system worked (with a few glitches), allowing users with a phone a bit bigger than a cell phone (detractors described it as “brick-size”) to call Antarctica, Mount Everest, or Washington, D.C., with equal ease. Expectations were high that Iridium would quickly catch on in a world in which people could not seem to get enough “anytime, anywhere” communication.

But in August 1999, nine months after the grand venture had debuted, Iridium filed for bankruptcy. In March of this year the company closed its doors and began preparations to de-orbit its satellites and incinerate them in Earth's atmosphere. (There is still hope that some venture will buy the Iridium system and operate it.) The reasons for the company's demise are complex, but in the end there were too few customers to pay off the enormous investment costs.

I began my quest for a Motorola/Iridium satellite in mid-1996, well before Iridium crested and fell. The company attracted my attention because it symbolized the beginning of an era. Government-backed international consortia such as INTELSAT dominated the first 30 years of communications satellite services. Now, as part of the push toward market economies, well-funded, energetic, private initiatives were driving development in the field.

A practical factor also spurred my effort—and made possible Motorola's donation. In developing Iridium, Motorola pioneered the mass production of communications satellites, building more than 80 spacecraft, including

ERIC LONG (2)



spares, in a few years. Prior to Iridium, such satellites typically were one-of-a-kind items, each taking years to design, assemble, and test, and each a substantial investment. Not surprisingly, each was launched, leaving no examples for museum collections.

Motorola's and Iridium's mass production approach, then, gave me hope; surely with such a program there had to be one satellite for the Smithsonian. I wrote and phoned Iridium, then Motorola. The companies' initial response was receptive but non-committal. They were in the midst of a multibillion-dollar effort, and my appeals on behalf of history were not their uppermost priority. But I persisted.

In early 1998, our discussions moved forward. Even with quantity production,

*continued on page 27*



*Enterprise*, the first space shuttle, is one of the artifacts to be unveiled at the National Air and Space Museum's Steven F. Udvar-Hazy Center.

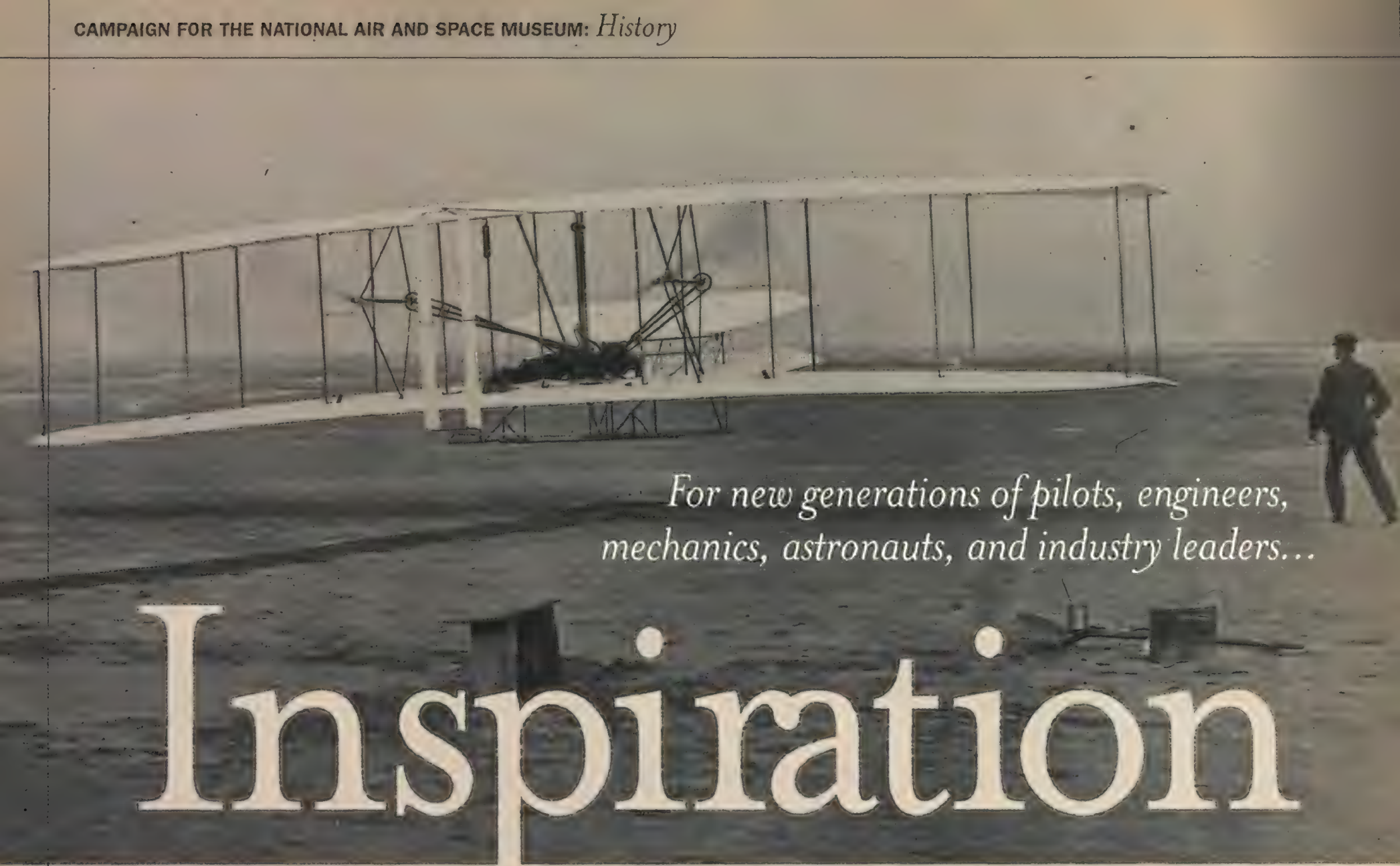
# *Our Future Takes Off*

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National Air and Space Museum  
Steven F. Udvar-Hazy Center





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# Inspiration

**N**o wonder the Smithsonian's National Air and Space Museum is the world's most visited museum. It is our privilege to document and display the entire history of aviation and space-flight, educating and inspiring people of all ages from around the world. We're also a vital center for research into the history, science, and technology of both flight and space exploration. But most of our growing collection – more than 90 percent! – remains either in storage or on loan. You simply can't see incredible artifacts like the Space Shuttle *Enterprise*, the SR-71 Blackbird reconnaissance aircraft, or the Boeing B-29 *Enola Gay*, from which the first atomic bomb was dropped. There's not enough room to restore, preserve, or display them.

"Stimulating imaginations and touching the hearts of future generations is why we're working so hard today. If we can inspire the next generation of explorers to reach for the stars, then we are succeeding."

**JOHN R. DAILEY**  
DIRECTOR  
NATIONAL AIR AND SPACE MUSEUM







**PAUL E. GARBER (1899-1992)** At 10, Paul Garber watched Orville Wright fly the world's first military airplane. At 15, he built a full-scale biplane glider based on a model he'd seen at the Smithsonian. One of his first jobs was as a messenger with the U.S. Air Mail Service. In 1920, he began working at the Smithsonian. For the next 72 years, he dedicated himself to the preservation of our aeronautical heritage. As our first curator, he helped assemble the most impressive collection of historic aircraft in the world.

From the Wright brothers' flight at Kitty Hawk to our journeys into space, the Museum documents the history of flight. **CLOCKWISE FROM LEFT:** The rugged and dependable Ford Tri-Motor played a major role in convincing the public of the safety and practicality of air travel. The Smithsonian's National Air and Space Museum is on the National Mall. In 1920, a temporary building on the Mall displayed the Smithsonian Institution's first aeronautical exhibits. Young visitors touch a moon rock in the Museum's Milestones of Flight Gallery.



#### AN EXTRAORDINARY RESOURCE

The National Air and Space Museum has five research and curatorial divisions. **AERONAUTICS:** Responsible for historical research, collecting, curation of exhibitions, and public service programs related to flight in the atmosphere. **ARCHIVES:** Responsible for document, film, and photograph collections relating to the history and technology of flight. **CENTER FOR EARTH AND PLANETARY STUDIES:** Conducts research related to planetary and terrestrial geology. Responsible for curation of exhibitions, and public programs related to Earth remote sensing and planetary exploration. **COLLECTIONS:** Responsible for the protection, preservation, conservation and restoration of the National Collection of aeronautical and space artifacts. **SPACE HISTORY:** Responsible for historical research, collecting, curation of exhibitions, and public service programs related to spaceflight.

#### DID YOU KNOW?

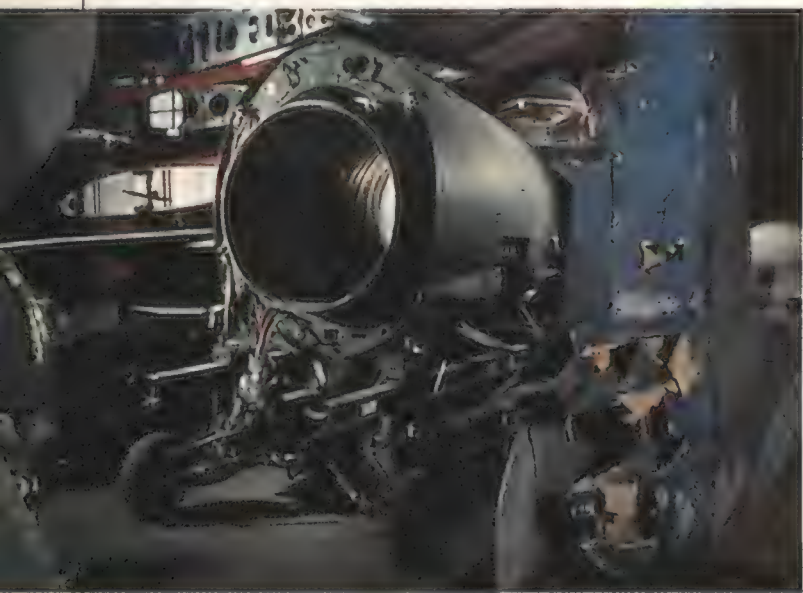
The National Air and Space Museum is the most visited museum in the world, with over 9 million visitors a year.



*Safekeeping the entire human history of flight  
is an extraordinary endeavor...*

# Preservation

**T**he Smithsonian Institution has been collecting aviation and space artifacts for more than 100 years. Most are currently housed at the Paul E. Garber Preservation, Restoration, and Storage Facility in Suitland, Maryland. But you can only tour a few buildings at the facility. Others are simply too full. Besides aircraft, thousands of engines, rockets, uniforms, spacesuits, balloons, artwork, documents, manuscripts and photographs now in storage record the rich history of flight. Many of the antiquated, World War II-type buildings do not meet museum standards — they have no humidity controls or air-conditioning. We desperately need a bigger, better facility.



The tattered tail is all that remains of this Nakajima J5N1 Tenrai. Using a combination of many different materials and tools (from microscopes to hair dryers!), museum specialists painstakingly restore aircraft to their former glory.

"There are so many treasures that people haven't seen — the Hawker Hurricane, the B-17 *Swoose*, Robert Goddard's 1935 rocket, a Matador missile, Skylab modules, and more. We have to preserve them for future generations."

**EARL CLAYTON**  
AVIATION BUFF AND MEMBER  
SMITHSONIAN LEGACY SOCIETY








Stacked together in warehouse storage, with wings removed and out of sight, classic planes and artifacts can teach us little and inspire no one. **LEFT TO RIGHT:** A Sikorsky JRS, a Yokosuka P1Y1 Ginga *Frances*, an Ilyushin Il-2, a North American AT-6, and the Cessna 180 *Spirit of Columbus* await restoration. Many priceless, unique aircraft and spacecraft are in danger of being lost to time, moisture, heat, cold, and shrinking budgets.



**LEFT:** Specialists restore the Pitts Special *Little Stinker*, the oldest surviving Pitts-designed aircraft. Donated to the Museum, it gained international recognition with aerobatic pilot Betty Skelton. When constructed in 1946, it was the smallest aerobatic plane in the world. **RIGHT:** The *Enola Gay*, a Boeing B-29, was specially modified for secret atomic bombing missions. It carried the first atomic bomb dropped on Japan in World War II. It has been carefully restored at the Garber facility. **BELOW:** Museum specialists inventory and inspect artifacts in the Collections Processing Hangar. As part of the acquisitions process, they document, photograph and clean objects before preparing them for display or storage.



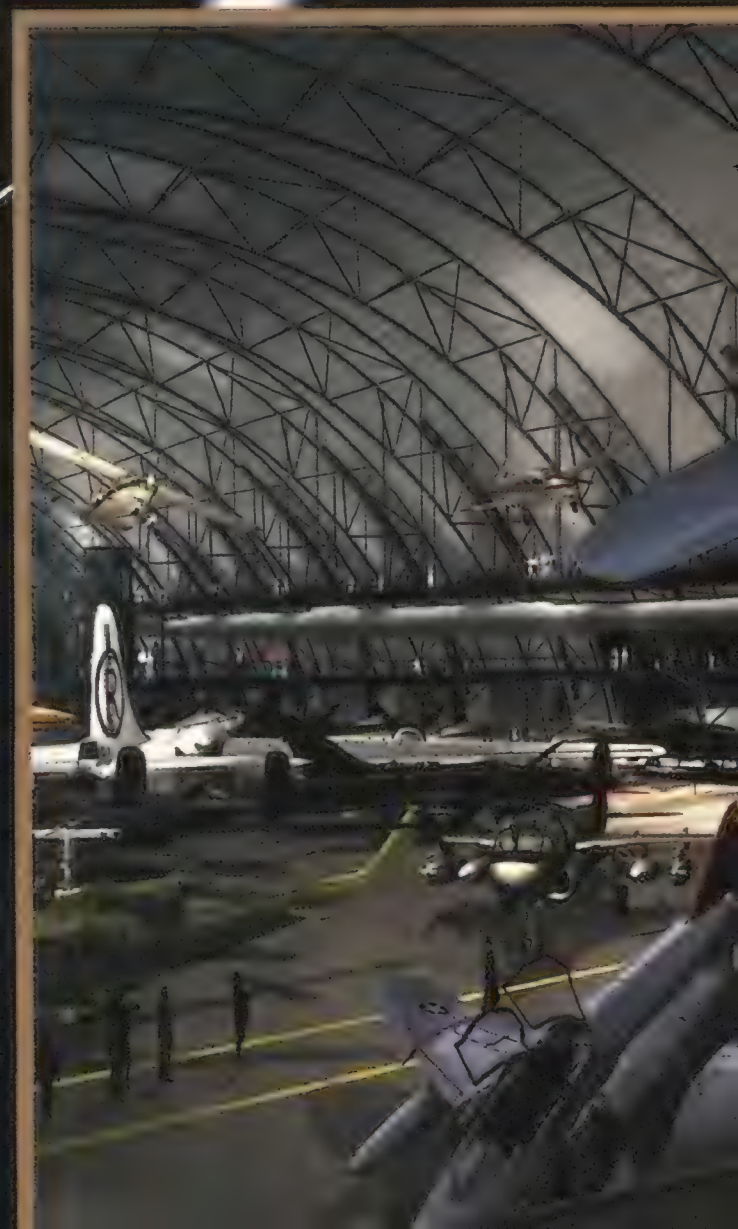




The fastest jet aircraft in the world, the SR-71 Blackbird was a secret weapon of the Cold War era, flying intelligence gathering missions for the U.S. Strategic Air Command at speeds in excess of Mach 3, or more than 3 times the speed of sound. Large artifacts like these cannot fit in the Museum on the National Mall.



After thousands of hours, restoration on the Aichi Seiran is nearly complete. The World War II Japanese bomber was designed to be launched from a submarine. This Seiran is the last one in existence.





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# Potential

**T**he Smithsonian's National Air and Space Museum will build the new Steven F. Udvar-Hazy Center at Washington Dulles International Airport, just south of the main terminal. A series of connected hangar-like structures, the Center will be the length of 2 1/2 football fields and ten stories high. More than 70 aircraft and 25 missiles and spacecraft will be suspended from vaulted roof arches. On the floor will be hundreds of other artifacts. With the completion of the Udvar-Hazy Center, the National Air and Space Museum will be the largest museum of its kind in the world. At last, we will have the room needed to display the complete history of flight, as well as space to grow.

Along with more than 180 aircraft and 100 space artifacts, the Udvar-Hazy Center will include classrooms and hands-on demonstrations for school groups, restoration in full view of visitors, archival resources, a large-format theater — even an observation deck to watch Washington Dulles International Airport traffic.

Working with a model of the new Center, a team of curators and an exhibit designer arrange aircraft to be displayed. They use a computer-aided design system to reduce artifact displays to a manageable size. This system helps the team put the puzzle together before the artifacts are even assembled.



"For me, giving to the Museum is rewarding. It saddened me to see the SR-71 Blackbird arrive years ago, only to be stored away. I'm delighted to support the creation of the Udvar-Hazy Center, so the SR-71 will finally have a home where everyone can see it."

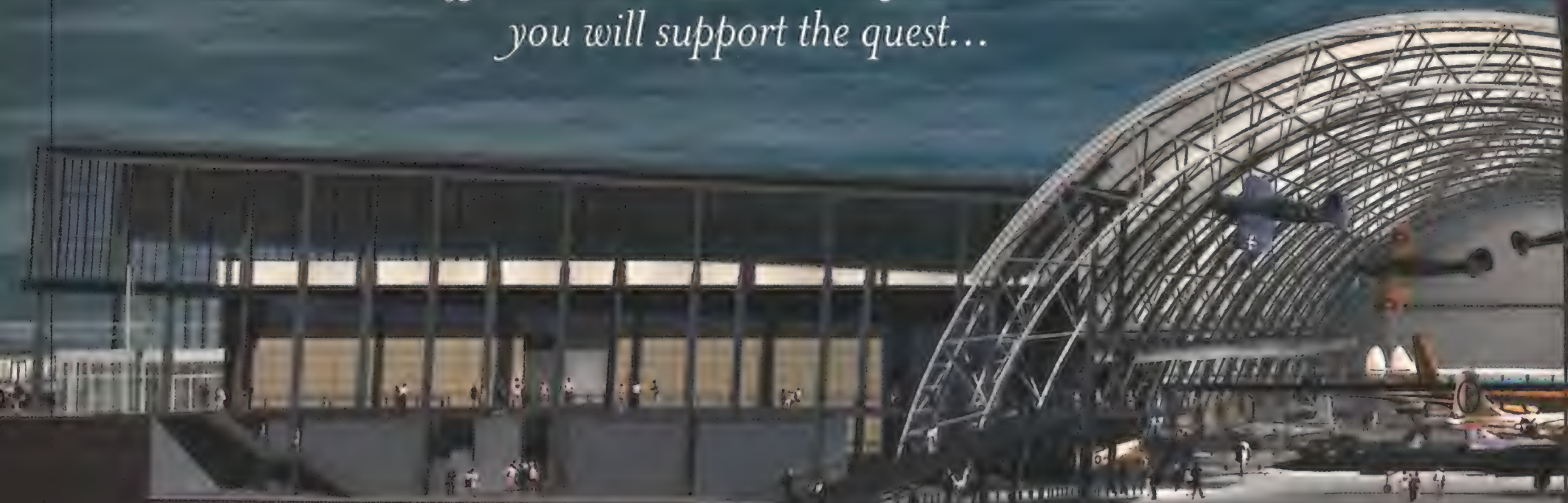
**ADRIENNE MARS**

MEMBER

NATIONAL AIR AND SPACE MUSEUM BOARD

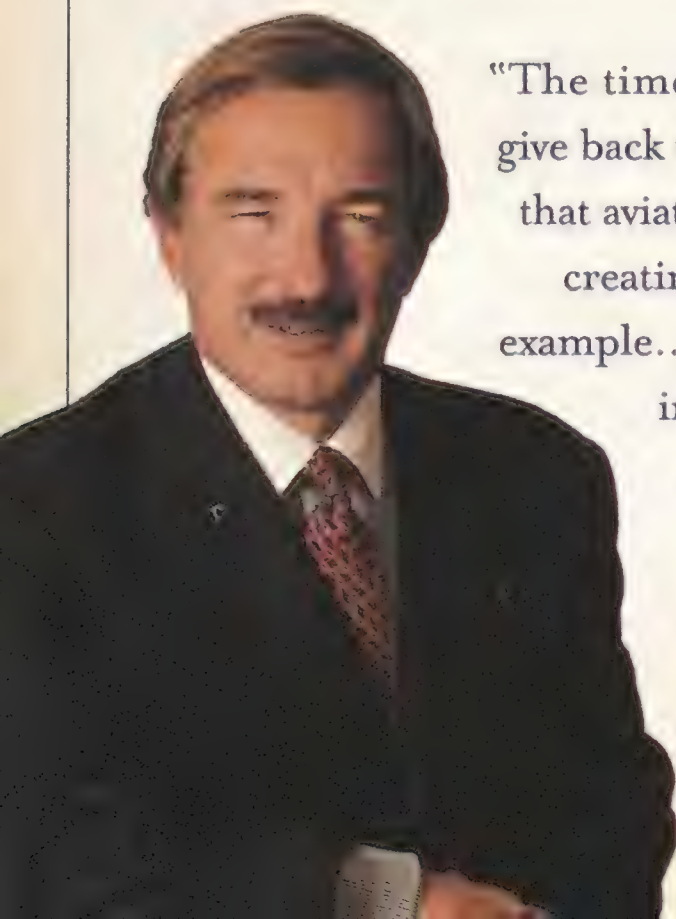


*If you have been touched by it,  
you will support the quest...*



# Passion

**S**teven F. Udvar-Hazy, a California businessman, pledged \$60 million to the Campaign for the National Air and Space Museum at a press conference on October 8, 1999. The Smithsonian's Board of Regents voted to recognize his extraordinary generosity and dedication to the "increase and diffusion of knowledge" by naming the Museum's companion facility in his honor. Building the new Steven F. Udvar-Hazy Center is a magnificent undertaking – one that will honor pioneers of the past and inspire explorers of the future. Congress has mandated that only non-Federal funds be used in the construction of the Center. The cost of the project is \$238 million, which will be secured from individuals, corporations, foundations, and other sources. Millions have been raised already, but much more is needed. We need your help, and the help of everyone who is passionate about preserving and displaying the remarkable history of flight.



"The time has arrived for my family to give back to America part of the reward that aviation has been instrumental in creating. I hope that our leadership example...will influence our colleagues in aviation, aerospace, and the airline sector to give tangible support to the National Air and Space Museum."

**STEVEN F. UDVAR-HAZY**  
CO-CHAIR  
CAMPAIGN FOR THE NATIONAL  
AIR AND SPACE MUSEUM







**LEFT:** Bob James, Chair, National Air and Space Museum Board, and former CEO, McCann-Erickson Worldwide.

**RIGHT:** Senator Howard H. Baker, Jr., Co-chair, Campaign for the National Air and Space Museum.



Senator John Glenn — astronaut and American hero — serves as Honorary Chair of the Campaign. A former pilot in the U.S. Marine Corps, and an astronaut in both the Mercury and space shuttle programs, Glenn's career spans more than 40 years.

In the main aviation hangar, many aircraft — never seen before in a museum environment — will be displayed at three levels. Suspended walkways will allow visitors to see them up close and from a variety of angles. These priceless artifacts will finally be accessible to millions of visitors. Each artifact has an extraordinary story behind it — an historic role, a particular accomplishment, or a technological milestone.



#### **STEVEN F. UDVAR-HAZY'S \$60 MILLION DONATION**

In 1953, at the age of seven, Steven F. Udvar-Hazy thrilled to the excitement of a weekend air show in Soviet-occupied Budapest. He listened to racing engines as silver fuselages climbed to escape their somber surroundings. "This was a defining moment..." says Udvar-Hazy, "when aviation captured my passion, my love, and my imagination. Nothing could extinguish those feelings about airplanes ever again."

Today, Steven Udvar-Hazy is the President, CEO and founder of International Lease Finance Corp. (ILFC) of Los Angeles, CA. His company purchases commercial airliners and leases them to major airlines. ILFC is the largest purchaser of commercial airliners in the world.

In the fall of 1999, Mr. Udvar-Hazy pledged \$60 million towards the construction of the National Air and Space Museum's new facility at Dulles Airport in Northern Virginia. His gift is the largest single cash donation in the 155-year history of the Smithsonian. As co-chair of the Campaign for the National Air and Space Museum, Mr. Udvar-Hazy is working to encourage others in the aviation and aerospace industries to play a vital role in the creation of this new complex.





Hundreds of dedicated people from all walks of life support the National Air and Space Museum as Docents, Explainers, and Museum Volunteers.

With their help, young visitors learn about flight, as well as the important role they could play in its future.



*You can help turn the dream into a reality...*

# Participation

**Y**ou can play an invaluable role in building the largest aviation and space complex in the world by supporting the Campaign for the National Air and Space Museum. All gifts, regardless of amount, are important to the success of this historic effort, and will be recognized at the Center. You may pledge a major gift over five years. You may elect to join the National Air and Space Society, or contribute to the National Aviation and Space Exploration Wall of Honor. You may choose to make provisions in your estate plan for the National Air and Space Museum. Whatever your level of support, you can take pride in helping the Museum preserve the first century of flight and inspire the next generation of explorers.

Design for the Wall of Honor at the new Steven F. Udvar-Hazy Center.

**RECOGNITION OPPORTUNITIES:** Donors may sponsor an area or artifact, from the Aviation Hangar (\$20 million) to the Space Hangar (\$10 million), to an exhibit station (\$1 million), to other opportunities under \$1 million. **PUT A NAME ON THE WALL OF HONOR:** A permanent memorial at the Udvar-Hazy Center, the Wall is dedicated to anyone with an interest in aviation or spaceflight. You can add your name or that of a loved one alongside the Wright brothers, Charles Lindbergh, Amelia Earhart, Chuck Yeager, and John Glenn. **JOIN THE SMITHSONIAN LEGACY SOCIETY:** Make a gift through your estate and join others who support the Museum through bequests, life-income gifts, and beneficiary designations. **JOIN THE NATIONAL AIR AND SPACE SOCIETY:** The Museum's membership program directly supports the building of the Udvar-Hazy Center.



"The Museum promises so much potential, to inspire kids, stretch imaginations, and preserve the amazing history of flight. My gift will help keep the promise, and you can help, too."

**PATTY WAGSTAFF**

3-TIME U.S. NATIONAL AEROBATICS CHAMPION, AIR SHOW STAR AND MEMBER, NATIONAL AIR AND SPACE MUSEUM BOARD





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the 100th anniversary of the first manned, powered flight by the Wright brothers.

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## IN THE MUSEUM

*continued from page 14*

each satellite was an expensive piece of hardware. The companies wondered if I would be satisfied with a model. No, I wanted as close to the real thing as possible. After all, real airplanes and spacecraft are the heart of the Museum, representing real sweat, labor, ingenuity, and passion.

By June we reached a happy agreement. They would donate a satellite consisting of a mixture of flight and engineering parts and including the most distinctive elements of the design: the spacecraft bus, the antennas, and the communications electronics (missing was a propellant tank used during orbital maneuvering, batteries, and hardware and electronics for stabilizing the craft). More than two years of reasoned pleading (and occasional barking and yipping) had paid off.

With its assembly line production methods, Motorola built satellites only as they were needed (flight models could be integrated and tested for space-readiness in less than two months). A satellite for the Smithsonian would have to be assembled. The Museum would acquire a communications satellite (a very rare occurrence) and would have a spacecraft built especially for it (a unique occurrence).

This good fortune led to the most enjoyable part of the experience. The Motorola folks invited me to their manufacturing facility in Chandler, Arizona, just south of Phoenix, to participate in the assembly. In Arizona's August heat I drove down to Chandler, past desert scrub, cotton fields, and numerous high technology enterprises.

Wearing a blue smock and paper booties, I puttered with a purposeful air around the clean room assembly and test area. My contributions in preparing the satellite were negligible. But my presence did give me the opportunity to talk with the integration crew and observe the innovations Motorola had achieved in satellite design and testing.

When I departed a couple of days later, with deeper insight into Iridium's technology and the people and dreams behind it, the satellite was nearly complete. In late November 1998, Motorola trucked the custom-built Smithsonian spacecraft to Washington, D.C. In October 1999, the satellite went on display as the centerpiece of a revised presentation on communications satellites. Iridium's legacy now is as a window on our recent past, a lesson for the future, and a story worth telling in the Museum.

—Martin Collins



With the completion of the pilot's seat, restorers have wrapped up their work on the National Air and Space Museum's Nieuport 28, a World War I fighter whose original seat was missing. Five years ago, retired volunteers Max Gainer, Jim Harrington, and Robert Taylor, all of whom had served in the armed forces during World War II, set to work on the Nieuport, which is on display at the Museum's Paul E. Garber Preservation, Restoration and Storage Facility in Suitland, Maryland. "This started out as an old man's project," says Gainer. Taylor and Gainer used old photographs and drawings to guide them in building the seat, a construction of interwoven plywood slats held together with copper rivets and washers.

## MUSEUM CALENDAR

**Hours** The National Air and Space Museum is open from 9:45 a.m. to 5:30 p.m. The Museum is open every day except December 25. General admission is free.

**Location** The National Air and Space Museum is located on the National Mall at 7th Street and Independence Avenue SW, Washington, D.C., just west of the U.S. Capitol. The closest Metro stations are L'Enfant Plaza and Smithsonian. The Museum is currently undergoing renovation; some galleries will be closed temporarily. For detailed information on gallery closings, visit the NASM Web site at [www.nasm.edu/nasm/NASMexh.html](http://www.nasm.edu/nasm/NASMexh.html).

**Tours** Free docent-led tours are given daily and depart from the Tour Desk, South Lobby, Gallery 108. Audio tours describing the NASM collections are available in English, French, Spanish, German, and Japanese. The audio tour kiosk is located near the Information Desk in the South Lobby. Headset fees range from \$4.50 to \$5.

**August 19 Evening Stargazing.** Join NASM astronomer Sean O'Brien for a look at summer's celestial sights. Activities begin at dusk—weather permitting—at Sky Meadows State Park near Paris, Virginia. There is a \$2 parking fee per vehicle. For information and directions, call (540) 592-3556.

**August 26 Monthly Star Lecture:** "Planets a Plenty." Learn how, when, and where planets form. NASM planetarium lecturer Steve Smith discusses what Earthbound telescopes and the Hubble Space Telescope have uncovered about other planets. Smith will also highlight what to look for in the night skies of September. Einstein Planetarium, 6 p.m.

**September 14 "Exploring Earth From Space: New Windows on a Changing Planet."** Come hear NASA scientists and other special guests discuss the latest discoveries about our changing planet and see spectacular color images and fascinating animations from recent satellite observations, plus computer models of hurricanes and thunderstorms. Langley IMAX Theater, 8 p.m.

**September 16 National Air and Space Society Lecture:** "The Marianas Turkey Shoot." Commander Alex Vraciu, U.S. Navy (ret.), will talk about his involvement in the battle for the Marianas Islands in June 1944, when U.S. Navy fighter pilots and anti-aircraft guns accounted for the destruction of 402 Japanese aircraft. Langley IMAX Theater, 8 p.m.

## Curator's Choice

Once a week a Museum curator will give a 15-minute talk about a subject of interest. Aug. 1, "Glenn Curtiss' V-8 Motorcycle"; Aug. 8, "The First Spacesuits on the Moon"; Aug. 15, "The NEAR Mission to Asteroid Eros"; Aug. 22, "Ruth Nichols, Society Flyer"; Aug. 29, "The Fokker D.VII."

**Paul E. Garber Preservation, Restoration and Storage Facility.** Get a behind-the-scenes look at the restoration workshop in Suitland, Maryland, where skilled craftsmen restore a variety of historic artifacts—everything from aircraft to satellites and missiles. Free tours Monday through Friday at 10 a.m. and Saturday and Sunday at 10 a.m. and 1 p.m. For reservations, call (202) 357-1400; TTY (202) 357-1505.

*Except where noted, no tickets or reservations are required. To find out more, call Smithsonian Information at (202) 357-2700; TTY (202) 357-1729.*



# Under the Wire

I had just finished spraying the main portion of a 40-acre cotton field in rural Tipton County, Tennessee, when I decided to make one more pass. I didn't want to miss any boll weevils hiding near the edges. I dove the Cessna 188B from about 300 feet toward the neat rows of young, green plants below. I had just begun to level off when I heard a strange scraping sound, then saw a thick, black electrical wire snap across the top of my airplane's long snout like a giant bullwhip.

Electrical wires are to cropdusters what land mines are to foot soldiers. Every year, ag pilots around the world have scores of disastrous tangles with power lines. Usually, there are four outcomes. The wire wraps around the airframe and drags the airplane to the ground, the impact so damages the aircraft that it can no longer fly, or the wire severs in such a way that it pumps

thousands of volts of electrical current through the aircraft, electrocuting the pilot. Then there is the happy ending: Cropdusters have been known to slice cleanly through the wires with minimal damage to the airplane or themselves.

My first passes through the cotton fields that morning had been straight and true. I could feel the wheels gently brushing the tops of the plants at times, which meant the spray bar at the trailing edge of the wing was at the proper height—about four feet above the plants. My turns at 300 feet were quick and precise, and I felt privileged to be getting paid to do a job that was so challenging and so enjoyable. The instant the power line smacked my windshield, that giddiness vanished. I was terrified, and out of my depth.

The airplane's spinner touched the wire first, and the glancing blow dented

the thin aluminum dome at the center of the propeller. The wire then scraped against the bases of the two propeller blades, but somehow it passed through the spinning disk without major damage to the blades.

The propeller was turning at 2,500 revolutions per minute, and if either of the two blades had separated, the resulting imbalance would have ripped the 285-horsepower engine from its mounts. That would have shifted the Cessna's center of gravity aft and made it uncontrollable.

The wire dragged across the top of the engine cowling, chipping the red and white paint as it bounced along the fiberglass surface. It passed over a series of latches holding down the lid on the 200-gallon chemical hopper. Then it bounced up against the windshield and hung there momentarily. I could see the



RUSSELL MUNSON



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insulation thinning as the windshield stretched it like an archer's finger pulling the string of a bow.

This all occurred in slow motion, though only a second had passed between the time I heard the scraping and when I saw the wire stretch across the windshield. I hoped for a miracle even though I knew I didn't deserve one. It had been stupid and irresponsible of me, a husband and father of two young children, to leave the office job I had held for 10 years to be a cropduster for the summer. How had I convinced myself that I would get through an entire season unscathed when so many more qualified fliers hadn't? This was only my second week of full-time flying, and the season would last another 16 weeks. I was profoundly disappointed in myself.

Purely by reflex, I cringed, ducked, and hauled back on the control stick, hoping that the airplane would begin to climb. Altitude would give me time and options.

The moment I pulled back, I heard a loud pop that sounded like a gunshot. Had the wire broken, or had one of the wings come off? I could feel myself becoming heavy in the seat, which meant the nose was rising. The airplane was beginning to climb.

Like most ag planes, my Cessna was equipped with a wire cutter. The people who design ag planes assume the aircraft will hit birds, standpipes, and electrical wires, and they take steps to mitigate such mishaps. The wire cutter on the windshield is just one example.

A sharp metal blade ran vertically from the base of the windshield to the top of the cab, where it attached to a thick cable that ran to the top of the vertical stabilizer. The apparatus was designed to keep power lines from decapitating pilots or severing the vertical tails of their aircraft. On this June morning, the wire cutter on my airplane did its job perfectly.

The loud pop I heard in the cockpit was the sound of the wire breaking cleanly. A brilliant shower of orange sparks danced in front of me, then fell away on both sides. I held the wings level as the airplane climbed.

There weren't any strange noises or vibrations as I gained altitude, and the controls felt solid as ever. The gauges on

the panel also told an encouraging story: oil, fuel, manifold pressure, and rpms were normal. Airspeed was falling below 100 mph as the airplane rose through 200 feet, then 300.

I leveled off and examined the tops of the wings for damage. The left wing seemed normal. But when I checked the right wing, my heart sank. I could see a deep indentation in the leading edge, and even worse, the aileron was creased and dented. If the aileron was too severely damaged, the airplane could become difficult or impossible to control, especially at high or low airspeeds.

I pushed forward slightly on the control stick and began a gentle descent. As the airspeed crept above 110 mph, I leveled off again. I wanted to get back to the airport as quickly as possible, but I was concerned that when I began to turn, the damaged aileron would cause the airplane to roll more and more steeply until it entered an unrecoverable spiral.

My other choice was to hold my present heading and attempt to land straight ahead. But that wasn't much of an option. The swampy Hatchie River was directly ahead, and if I went down in those miles of marshy bottom lands, no one would ever find me. I had to turn around.

I stepped on the left rudder pedal and the airplane began to yaw. I nudged the stick slightly left and began a shallow turn. Some of the tension that had been

building in me began to ease. The engine was still running and the airplane was still flying.

I let the bank angle steepen as I pointed the airplane toward the airport, then rolled out of the turn. At that point, I impetuously began a steep right turn. As I became more certain the airplane wasn't too badly damaged, I began asking more of

it. I dove for an instant, then pulled into a climb. I dove a little more steeply and let the airspeed build, then pulled hard on the stick and began a steep climbing turn, the way I did when pulling out of a field after a spray pass.

The airplane was full of chemicals and fuel, and I was tempted to go ahead and resume spraying. The smart thing would be to return to the airport. I could let Ben Baker, the flying service owner, check out the damage and decide whether he wanted the airplane to continue flying.

But the collision with the wire had so unnerved me that unless I went right back to work I might never have the courage to get back in an ag plane. Also, I suspected that I might be summarily fired when I returned to the airport. This might be my last hour as a cropduster, so I decided to make the most of it.

I spotted the next field on my target list, circled overhead looking for obstacles, and took a few deep breaths to calm myself down. Then I rolled steeply and dove toward the cotton rows below. I focused on flying as accurately as I possibly could. That first pass was followed by a steep climb, a hard turn, and another plunging descent in the opposite direction. After a few more passes, I found myself falling into a comfortable rhythm.

I had been flying for about an hour after hitting the power line and was about to head back to the airport for more fuel and chemicals when a familiar voice crackled through the earphones in my helmet.

"We've got a wire down in Field 68," said Milton Southall, the Department of Agriculture supervisor in charge of the area. "Dave, did you get a wire?"

There was no denying my culpability. Field 68 was in my area, it was on my target list, and certainly the people who lived nearby had seen my red and white airplane flying overhead.

"I'm afraid so," I answered weakly. "I'm on my way back to the airport."

Covington Municipal Airport was only a few miles east, and I could see the runway plainly from my vantage point about 300 feet above the ground. On the way back, I circled above the spot where I had clipped the power line. Southall's white pickup truck was parked there, along with a pair of vehicles from the local utility company. A woman was standing outside a mobile home, wearing a pink robe and matching slippers and smoking a cigarette.

I circled a few times as I surveyed the scene below. The power line had been strung across a remote corner of the field about 15 feet above the ground from a utility pole to the mobile home tucked deep in a cluster of trees. The line was still down near the trailer, and a couple of utility workers appeared to be splicing it where my airplane had severed it. Their faces turned up at me as my airplane passed overhead. The woman in the pink robe looked up too. She raised her right hand as if to shield her face from the morning sun—but as I looked closer, it became obvious she wasn't shading her eyes.

Purely by reflex, I cringed, ducked, and hauled back on the control stick, hoping that the airplane would begin to climb. I heard a loud pop that sounded like a gunshot. Had the wire broken, or had one of the wings come off?



As I approached the airport for landing, I went through the pre-landing checklist with a few alterations. Chemical pump off, check. Propeller rpms to full increase—no, better take it easy on the blades and leave them at 2,500 in case the wire damaged them. Mixture rich, check. Flaps down—well, not this time. Better not to alter the airflow over a possibly damaged wing.

I touched down as usual at about 60 mph, and pushed forward on the control stick to pin the main gear tires on the runway. As I slowed to 30 mph, I reduced the forward pressure and let the tailwheel plunk down to the ground with a springy bounce, then its customary shimmy and shake. So far so good. I opened the left window, then the right, and allowed fresh air to blow over me.

Even though it wasn't yet 9 a.m., the temperature outside already was above 80. My face and neck were covered with sweat, a result of the heat—and my fear that I was about to be fired.

I couldn't blame Baker if he decided to send me packing right then. It had been stupid to hit the wire. It was even dumber to keep working afterward. I knew the Cessna might be damaged. Why had I continued? Even as I rehearsed it in my mind, my rationalization—that I had been afraid to stop—sounded absurd.

I taxied to the gas pump, swung the airplane around, and set the parking brake. I glanced toward the office and saw mechanic Randy Travis walking briskly toward me. His work area was well within earshot of the CB radio in Baker's office, and surely he had heard Southall ask me about the clipped wire in Field 68. He looked up at me and dragged a finger across his throat, the signal to shut down the engine—but it also seemed to signal the end of my short career as a cropduster.

As soon as the propeller stopped, Travis ran his coarse hands gently up and down the black metal surface. He took off his sunglasses and scrutinized the blades for cracks. As I climbed out of the cockpit, he examined the right wing.

"Hear you got a wire," he growled.

"Yeah," I confessed. "How bad is it?"

Travis shrugged. The spinner at the hub of the propeller had a deep dent in it, the right wing had a foot-long horizontal crease in the leading edge, and the 3/8-

inch-thick cable that ran from the wire cutter on the windshield to the top of the vertical tail was blackened and slack.

"Aw, hell, I've seen a lot worse than this," he said. "You got off light. Sure did. You got off real light."

I pointed out the crinkled aileron on the right wing. "You mean you never noticed that before?" he said. "That thing's been that way forever. The creases only show up in the sunlight when you're looking down from the top."

Travis ran his fingertips over the base of the propeller where the paint was scraped off.

"See these abrasions?" he asked. "That's where the wire was pulling against the prop. Good thing it was the thickest part of the blades. If you'd hit the wire with the tips, they'd have busted right off."

I told Travis I hadn't even seen

the power line until it was pressed against my windshield. "Look here," he said, pointing to the spinner. "You centerpunched that damn wire. Couldn't have hit it any more square if you'd been aiming for it."

I appreciated the way he minimized the damage to the airplane and credited me with severing the wire so artfully, as though I had planned my lucky escape. But I felt bad that I had created so much work for him. I assumed he'd have to replace the spinner and prop and repair the dented wing before the airplane could fly again. I asked if it was a matter of days or weeks.

"When are you going to be ready to fly again?" he asked.

"If I've still got a job, I'm ready to fly right now," I said as convincingly as I could.

"Hell, you're not going to get fired for hitting one lousy wire," he said. "Just don't make a habit of it. It's a long season, and I want this airplane to be as pretty at the end as it is right now."

Pretty is a subjective term, especially when referring to ungainly, bug-splattered airplanes that are full of toxic chemicals. But my respect for this particular Cessna grew as a result of our first close call together. And during the next four months and 500 hours of cropdusting, before I returned to my career as a journalist, we managed to maneuver over and under—but thankfully not through—thousands of similar obstacles.

—Dave Hirschman

# Time Traveler



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# Heavy Duty

I have always wanted to be a naval aviator. It sounded like a profession that would give me a sense of accomplishment, the chance to serve my country, and a great way to pick up girls. In June 1950, I got my opportunity: The Korean War broke out.

At the time I was in Tennessee teaching flying, having just finished my second year of college. After a lengthy exchange of letters and calls with the Navy, I was finally told to report to Naval Air Station Memphis for a flight physical. There was just one problem: I was what would now be called horizontally challenged. Back then, the word was "skinny." I was six feet tall and weighed 132. According to the Navy's standard, I was supposed to be at least 138. I'd begun drinking a couple of malts a day and eating until the thought of food made me queasy. But I gained exactly zero, zilch, nothing.

Someone pointed out that bananas have a lot of weight per volume, so they might be a quick way to put on pounds. The day before I was to leave for Memphis, I bought nine pounds, figuring that, without skins, I'd have at least six pounds of fruit to eat.

The next day I arrived at the train station, suitcase in one hand and bag of bananas in the other. I pulled the first banana from the sack and peeled it. After the fifth, the people in the waiting room were starting to avoid looking at me.

The train pulled in and we all boarded. I spent the next four hours following an efficient method that

I had developed: (1) Take a banana from the sack. (2) Peel it. (3) Eat it. (4) Gag. (5) Repeat steps 1 through 4.

When I arrived at Memphis, I caught a cab to the air station. The doctor there, with whom I had corresponded, was sympathetic to my problem, and after the weigh-in he confided in a low voice that I was "still short about half a pound." He told me that there was a water fountain down the hall and suggested that I go get a nice drink of water to "top things off."

I did as he suggested, then sloshed back into the examining room. Outstanding! I made the minimum! My orders were to report to NAS Pensacola the next morning to begin training as a naval aviator.

"Will they weigh me again at Pensacola?" I asked the doctor.

"Of course they will," he said.

I don't remember the trip to Florida well, other than it

required quite a few visits to the facilities, and since I was in an upper berth, the guy below me wasn't happy about that.

By the time I arrived at the air station, I needed to replenish my bananas. Directly across from the base hospital were a commissary and a service station. There was only one thing to do.

I stopped at the commissary, then walked over to the service station's men's room. I sat down on the only available seat and proceeded to peel and eat.

By the time I walked in to the examining room, I was not well. But after the pharmacist mate took my blood pressure and pulse, he signed my orders and waved me on.

Wait a minute! "Aren't you going to weigh me?" I asked. I'd be damned if all those bananas were going to go to waste.

"Didn't they weigh you at Memphis?" the corpsman asked.

"Well, yes," I said, "but they said I'd be weighed here too. I insist!"

The corpsman edged his way to the door. Keeping his eyes on me, he hollered, "Chief! You'd better get in here!"

The chief appeared, and once apprised of the situation, quietly explained to me that since I had been weighed in Memphis yesterday, it was not necessary that I be weighed again today, and furthermore, I should understand that if everyone who came through there demanded to be weighed, the personnel wouldn't have much time to do the more important medical work that was required of them, now, would they?

Well, he didn't use those exact words. What he actually said was: "Report to the station duty officer on the double and get your \*%\$#! skinny @\$# out of my dispensary, NOW."

That was September 24, 1951. I have not eaten a single banana since.

—William K. Kershner



DAVID POVILAITIS



*"We should never forget..."*



**"Our pilots and crews were such a crucial factor in winning World War II. Making this gift honors aviation's historic role and helps ensure that future generations will never forget our accomplishments."**

— GENERAL WILLIAM S. RADER, USAF (RET.) AND HIS WIFE MAJOR STEPHANIE C. RADER, USAF (RET.) in the Museum's World War II gallery. The mural behind them depicts a B-17 in the 303rd Bomb Group, which General Rader commanded during World War II.

As a B-17 pilot, he flew combat missions in both theaters in World War II - 72 of them over occupied Europe and Germany. She was a WAC Captain in London when their wartime romance began. They're honored to be part of the greatest generation—those who protected and defended the freedoms we all enjoy today. That's why General and Mrs. Rader are proud to have included a generous

bequest to the National Air and Space Museum in their estate plans. They are now members of the Smithsonian Legacy Society.

Find out how you can include the National Air and Space Museum in your estate plans. Fill out and return the reply form below, or call 202-357-2493. You may also e-mail [gayle.union@nasm.si.edu](mailto:gayle.union@nasm.si.edu). Remember those who flew for our freedom!

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by Carl Hoffman

*Photographs by Phil Schofield*

# Back in the *Race*

Can Darryl Greenamyer turn Reno's new Sport class into NASCAR with wings?



In the 36 years since pylon air racing began at Reno, Nevada, no name has been more evocative of the speed and horsepower of the world's fastest motor sport than Darryl Greenamyer's. The former Lockheed Skunk Works test pilot has won the Unlimited class seven times, more than any other competitor, despite being disqualified once and banned from racing for a year. In 1969 he broke the world piston engine speed record. In 1977 he snatched the world low-altitude speed record from the U.S. Navy in an F-104 Starfighter that he put together himself out of parts he'd collected here and there. Even now, over two decades after his last race at Reno, fans there still seek a handshake or autograph.

All of which is why there is something a little jarring about the new raceplane being built before Greenamyer's mischievous blue eyes one spring day in a prefabricated metal building in Redmond, Oregon. The fuselage doesn't have a single rivet. It is in two cardboard-thin halves of molded black carbon-fiber, each weighing 16 pounds, being glued together by a 26-year-old southern California surfboard maker with a blond goatee. When complete, its engine will have six cylinders and 550 cubic inches, a lawnmower engine compared to the 18-cylinder Pratt & Whitney R-2800 that cranked out 3,200 horsepower in Greenamyer's old F8F Bearcat racer. The new raceplane is, of all things, a production kit airplane; you and your friends can buy its twin for \$40,000 (excluding engine and avionics and the cost of some 400 hours of assembly).

But if all goes according to plan, Greenamyer will capture his eighth Reno victory this September when his new Lancair Legacy runs the pylons in the Sport class. Open to production kit airplanes with 650-cubic-inch or smaller engines, it is the newest racing class at Reno. Even more important, Greenamyer's return to Reno in a high perfor-

*In the 1960s Reno air races, Darryl Greenamyer and his Bearcat were unbeatable (right). Today, he's trying to create the same excitement in a kit-built Lancair Legacy (left), an airplane the Bearcat could eat for breakfast.*

mance kit airplane is the first ripple of a gathering wave that may someday sweep the mighty Unlimited-class warbirds off to history. "The Sport class," says Jon Sharp, whose *Nemesis* racer has won the Formula One class nine consecutive times, "is the future of air racing."

Reno has always had four classes: Formula One 100-hp homebuilts, Biplane, AT-6, and Unlimited, but it's the last that has defined the place and the sport for most racing aficionados. The reason is speed. While Sharp's 100-hp *Nemesis* strains to crack lap speeds of 250 mph, the fastest Unlimited warbirds, powered by Merlins and radials of 3,000 horsepower, approach speeds of 500 mph. The Unlimited category became dominated by World War II fighters for two reasons: speed and affordability.

When Nevada cattle rancher and air racer Bill Stead held the first pylon races at Reno in 1964, "unlimited" simply meant the fastest piston-engine airplane you could put in the air, with no constraints on airframe design or powerplant size. Anything was possible—pilots even raced in bombers. Greenamyer didn't enter that first race in 1964 with a Bearcat because the Grumman had fought bravely in the war, but be-

cause it was the fastest airplane he could find for the least amount of money. Greenamyer was a test pilot for Lockheed; he was hardly rich. Ditto with the other air racing legends. Lyle Shelton, winner of six Unlimited titles and owner of the record-setting Bearcat *Rare Bear*, was a Navy pilot. Bill "Tiger" Destefani, also a six-time Unlimited winner, was a farmer. In 1965, the first year he won, Greenamyer's hotel bill for a week at Reno was \$210. His Bearcat, the most heavily modified airplane at the race, was worth \$8,000. The warbirds were cheap and there were plenty more out there.

By 1997, a stock, airworthy P-51 Mustang was worth \$1 million and up. Making it fast enough to win the Gold division meant radically modifying it at a cost of another \$500,000 or more, and racing it cost at least \$100,000, when you factored in spare parts, food, lodging, and transportation. An engine alone cost as much as a three-bedroom house. First prize that year: \$57,373. "I've never been a math wizard," says Michael Houghton, president of the Reno Air Racing Association, "but you can see that just doesn't pencil. You just have to love the sport."

When it comes to money, love only goes so far. Of 43 airplanes entered in



JIM LARSEN



the Unlimited category in 1997, only half a dozen were fast enough to compete for first prize. Over 100 miles an hour separated the fastest airplanes from the slowest. "We've got a big problem with mismatched speeds out there," said racer Gary Levitz at the time. The races were bordering on predictable. Matt Jackson, a consistent top 10 finisher, was frustrated. "To go fast, people have to spend \$1 million and no one wants to do it," he said. And who could blame the owners? It was one

thing to go all out and risk blowing an engine or crashing an airplane worth \$10,000, and quite another to do it in your rare piece of history worth \$1 million or more. "It's all club racing now," said Jackson. "Reno has turned from an air race with a little bit of an airshow into an airshow with a little bit of racing." The Reno box office was starting to feel the effects of the change. Says Houghton: "By 1996 we had lost a million over four years and were close to bankruptcy."

"Some of these warbirds are getting toward the end of their time," says Shelton. "To take a new Sea Fury and make it go fast doesn't make economic sense anymore because it's worth so much as a stock airplane. We need more sponsorship help and more TV, and it's got to be more than just ESPN in the middle of the night." Sponsorship money has become the Holy Grail.

Over the past 20 years, air racers have watched as stock car racing and NASCAR have risen from the dirt tracks of the South to become one of the country's richest and most popular sports. The big automakers poured millions into racing teams running cars that looked just like the one Joe Sixpack parked in his driveway. Love of the sport had nothing to do with it: Big-time auto racing flourished because it sold cars. "Win on Sunday, sell on Monday" was the mantra. When you bought a Monte Carlo, you were buying a high-tech, high-performance machine born on America's meanest ovals, or so the marketers had you believe.

But Formula One raceplanes, single-seat biplanes, half-century-old World War II trainers, Mustangs—who was going to sponsor them? Almost no one in general aviation or among the 150,000-odd spectators at Reno could afford or even want to own the sort of airplanes being raced. "Why would anyone pay money to sponsor a Mustang or a T-6?" says racer Lee Behel. "North American doesn't build airplanes anymore. Who cares which T-6 or which Unlimited wins? Grumman or Rolls-Royce doesn't care! Biplanes and Formula One racers are made in someone's garage and no one stands to profit from a winner. Just look at the sponsors Reno does have: Shell Oil, insurance, beer, Dial soap. What the hell does air racing have to do with soap? Nothing! It just happens that the Dial family loves aviation and they sponsor Reno because they like it, not because it makes good business sense."

One way around the problem, a few

*FAA rules say a kit airplane can be only 49 percent factory-built. Once the project is out of Lancair's hangar, Greenamyre (at right) and Andy Chiavetta will pick up where Lancair left off.*





forward-thinking Unlimited racers thought, was to ditch the warbirds. Why was everybody so hooked on technology from the 1940s? There was no rule that said an Unlimited airplane had to have fought in World War II. "When people use their heads instead of their hearts and stop being all nostalgic about warbirds, then we'll have a race," Jackson says.

In the late 1960s Greenamyre approached Cessna with a radical proposal along NASCAR lines: He offered to race a Cessna 210 powered by an Allison engine. That would shake things up! And if he beat the wings off those old Bearcats and Mustangs, he'd usher in a whole new type of race, flush with sponsors. Cessna, needless to say, thought he was crazy. "They were worried about liability," Greenamyre recounts.

If racing high-powered versions of stock general aviation aircraft wasn't the answer, maybe custom-designed and purpose-built racing machines was. When he won Reno in 1965, Greenamyre's lap speed was 375 mph. Over the next 10 years the top racers succeeded in squeezing ever more speed out of the same old airplanes until lap speeds approached 500 mph. And there they've stayed for over a decade. The Bearcats and Mustangs are at their design limits. Lyle Shelton's *Rare Bear* is fast, but so unstable it barely stays in the air. "At this point it probably takes a thousand horsepower to get one more mile an hour," says Destefani. "If you had a clean piece of paper, then you could design a plane for air racing, not combat missions." And maybe, if you could get more competitive airplanes flying faster, the thrill of Unlimited racing would return, along with fans and money.

The diagnosis was right but the treatment wasn't. There is nothing simple or cheap about designing and building an airplane, especially one cranking thousands of horsepower and nosing the speed of sound. The Unlimited homebuilt *Tsunami* that was coming into its own in the late 1980s killed pilot John Sandberg in 1991. Two years later Burt Rutan's \$2 million one-of-a-kind Pond Racer killed pilot Rick Brickert during qualifying laps. Around the same time Greenamyre and Skunk

Works engineer Bruce Boland started building *Shockwave*, a mongrel designed with the tail of an F-86, the outer wing panels of a Sea Fury, the propeller hub of a Lockheed C-130 and the blades from an Electra, and a massive 28-cylinder Pratt & Whitney R-4360 engine. Matt Jackson too started building a computer-designed one-off using the wings of a T-2 Buckeye. "I've run the numbers and Darryl's plane isn't as fast as he thinks it is," Jackson said at Reno in 1997. "I'll kick his ass!" But years have passed and both airplanes remain unfinished, hobbled by the multi-million-dollar expense of building a sponsorless airplane designed to win a single event now worth all of \$100,000. Meanwhile, Gary Levitz's *Miss Ashley II*, a Mustang-like fuselage with wings from a Learjet, disintegrated mid-race last year, killing Levitz. The dream of a new kind of airplane has proved anything but easy. As Tiger Destefani says, "Talking about it and doing it are two different things."

Then one day, along came Lee Behel. A former F-4 pilot in the Nevada Air Guard and owner of a car dealership in San Jose, California, Behel was on to something no one else at Reno was: kit aircraft. Long gone was the cliché

of a newfangled death trap scribbled on a paper napkin and cobbled together in the back yard. As composite technology had revolutionized the sailboat industry, so it was revolutionizing general aviation in dynamic small workshops and companies. Using composites of fiberglass and carbon fiber, aeronautical engineers were designing small, light, strong aircraft that flew faster than World War II fighters on one-tenth the horsepower. Abetted by the temporary withdrawal of manufacturers like Cessna from the single-engine market, homebuilt experimental airplanes became the largest selling category of new airplanes. Dozens of companies, from Lancair to Renaissance Composites to Questair, sprang up, all elbowing for a share of a growing market. "The importance of the experimental market to us and to general aviation is huge, much more so than most people realize," says Chip McClellan of Teledyne Continental Motors. "Homebuilt sales represent a sig-

*Onward and upward: from the mold shop to the main hangar for wing attachment aboard Greenamyre's \$200 Toronado. "Aside from having to start it with a screwdriver, it's a nice car," Greenamyre says.*







COURTESY DARRYL GREENAMYER



DON BERLINER

*When he got bored with whomping the competition at Reno in the Bearcat (left), Greenamyers built an F-104 from parts scrounged over 12 years. In 1977 he broke the low-altitude speed record with a 988-mph dash over a three-kilometer course in the high desert. The sonic boom caused car headlights to explode.*

nificant size of our sales [to manufacturers] today, and eight years ago we didn't even work with them." Even now, with Cessna manufacturing singles again, homebuilt airplanes outsell production airplanes by three to one, and companies that started out as homebuilts, like Lancair, are beginning to make production versions of their kit airplanes. Says McClellan: "Those airplanes represent the future of general aviation."

Lee Behel understood all this; he owned a Lancair 360 and had even traded a Porsche 911 for a Questair Venture. Behel's brainstorm: a sport racing class sponsored by the competing experimental manufacturers, most of which made the high performance of

their airplanes a key selling point. "I thought if we could get the kit manufacturers competing with each other, showcasing products that were available to the public right then on race day, then we'd get the same marketing opportunities as car racing. The manufacturers would want to see their products win, they'd come up with technical innovations, and we'd have an exciting race." And unlike the Formula Ones, T-6s, biplanes, and warbirds, the Lancairs and Renaissance Berkuts were airplanes that just about any Joe or Mary in the stands could afford to own and fly themselves.

Behel was on, Reno officials said, providing he could find a sponsor to underwrite the cost of the new class.

Lancair jumped in. For years the company had advertised its kits as "the Ferrari of homebuilts," and its top-of-the-line four-seat Lancair IV-P was the fastest single-engine piston airplane in production. In 1990 and 1991, test pilot Dave Morss, in a Lancair IV prototype, posted a lap qualifying time sufficient to land him in the Unlimited division, but last-minute mechanical and communication complications prevented him from racing in both years. "We wanted to get into racing," says Bob Fair, Lancair's general manager, "because Reno draws a lot of pilots who have no understanding of how sophisticated and high performing an experimental kit airplane is, and think it's still something on the back of a magazine."

Seven years after Morss' efforts to qualify, kit airplanes finally got a class of their own. In the first Sport class race, held in 1998, Morss, averaging 308 mph in his company-owned Lancair IV, beat seven competitors. Lee Behel, flying a nearly stock Questair Venture, placed second at 297 mph. Last year, competition intensified and speeds increased. Morss, flying the Lancair IV with a six-cylinder Continental pulling 600 horsepower and fitted with a custom Hartzell highly swept three-blade prop, won again, this time with qualifying speeds of 335 mph and a winning speed of 319. Several other Lancairs competed, along with a number of Ventures and Glasairs.

Lancair hoped to generate sales from its sponsorship of the class, and did. Renaissance Composites, maker of the canard-wing Berkut that placed second in one race, "got a tremendous amount of attention, press, and respect," says Renaissance president Dave Ronneberg. Continental was so happy with both the engine it goosed for Morss and the attention it garnered that it has decided to manufacture and market a special edition engine, the Reno Banshee 550. Says Ronneberg: "The interest in the sport class has been phenomenal. With homebuilts pushing up against the backside of the Unlimiteds, people sat up and took notice." One of those people was Darryl Greenamyers.

Among pilots, Greenamyers was the kind of flier who'd rather make rules



than follow them. Early on, he developed a passion, as he put it years later, "to show those bastards"—those bastards being just about everyone who said "no" or "it can't be done" to Darryl Greenamyer. By the time he was 25 years old, in 1961, he was test flying the Lockheed F-104 Starfighter, then the fastest production fighter in the world. Just two years later he be-

came a test pilot at the Skunk Works. Though a civilian, he graduated from both the Air Force Aerospace Research Pilots School and the Navy's Top Gun program. He flight tested U-2s and the hottest airplane in the world, the CIA's Lockheed A-12 and the SR-71.

But what really set Greenamyer apart were his escapades outside Lockheed. He loved speed and he had an intuitive aerodynamic and mechanical understanding of how to get it—plus, he'd been schooled in its complexities by the world's best aeronautical engineers. In 1964 he entered the first Reno race with a nearly stock Grumman F8F Bearcat. When the dust had settled on the big race, Greenamyer had won the second of four heats and placed fourth in the point standings, but he was disqualified for landing at a different airport when he decided that he couldn't safely land on the sand-covered metal-mat runway at Bill Stead's Sky Ranch.

In 1965, to wring more speed from the airplane, he and Skunk Works engineer Bruce Boland replaced the cock-

pit canopy with the searchlight cover off a P-3 Orion, clipped its wings, streamlined the engine cowling, installed a radical water-boiling cooling system, replaced the propeller with one from a Douglas Skyraider, and reduced its weight by 1,200 pounds. Over the next seven years he won six times, took the absolute speed record in 1969, and was banned from racing in the 1972 season for not pulling up to a minimum safe altitude when another racer called a Mayday ("It's dangerous to pull up; you can't see your competitors," he says) and for flying too low and too close to the grandstands. Then the Federal Aviation Administration suspended his license for six months. In 1977 he won again. Then he walked away from Reno, busy with a new project: breaking the low-altitude speed record. (The Bearcat sits in the National Air and Space Museum's Garber facility, ready for display in the museum that will open at Dulles Airport in Virginia in 2003.)

Breaking the speed record required flying through a three-kilometer timed course four times, in opposite directions to negate the effects of wind. "So it's really more of an endurance test because lots of planes can go that fast but they can't do it four times," Greenamyer says.

It was much more than that. Above an airplane's "redline" airspeed, an airframe can begin oscillating, or its flight control surfaces will begin fluttering, and that can happen so fast and so powerfully that one instant the airplane is straight and level and the next instant it disintegrates. A lucky pilot might catch his airplane beginning to oscillate, but as often as not in an effort to correct the problem he overcompensates, makes it even worse. In the denser air of low altitude, airplanes reach their redlines at lower speeds, and 100 feet off the ground there's no room for error.

Greenamyer wanted to use an F-104 because he thought it was "a great but malignant airplane." But in the late 1960s they hadn't been released to civilians. "It started out low key and for the first four or five years I was just collecting parts, but then I got to where I said, 'By golly, I can do this' and I got more serious," he says. "I got the front end



*Greenamyer gives his racer-in-progress the white-glove treatment (left), while Chiavetta and Lancair salesman Orin Riddell wrestle with the cockpit fuselage.*





The big draw at Reno has long been the Unlimiteds, the highly modified heavy iron like the P-51D Mustang Dago Red (right). Race speeds top out around 450 mph, but in 1983, set loose on a straightaway, Dago Red set a record of 517 mph. Such speeds are brutal on Merlin engines, which at the races spend most of their time undergoing maintenance (below).



RICHARD VANDER MEULEN (2)

from a Lockheed mockup, the tail from a junkyard in California, and the horizontal stabilizers from a scrapyard in Tucson."

Assembling it all was the ultimate backyard project. He and his mechanics drilled out all the round-head rivets on the mockup, which was never meant to fly, and replaced them with flat-heads to reduce drag. He traded sponsorship of the Bearcat for 1,000 hours of electrical work. Twelve years after starting his quest, he had a complete, homebuilt F-104 Starfighter. It was 2,000 pounds lighter than a stock -104, carried 200 extra gallons of fuel, and sported an instrument panel upholstered in red velvet.

On October 24, 1977, at Tonopah, Nevada, Greenamyer climbed in *Red Baron*, flew 25 miles out, turned around, lit the afterburner, and accelerated toward the three-kilometer course. When he hit the course not quite 90 seconds

later he was barely 100 feet off the ground, traveling some 1,000 mph. He was 100 mph over redline. "The plane is very sensitive," Greenamyer says, "and you're hauling ass! I started to oscillate once, but just let go of the stick and it steadied."

To those below, *Red Baron* was dead silent; he was traveling Mach 1.3. The silence didn't last long. The sonic boom blew out a woman's contact lenses. The headlights of cars parked below exploded. Greenamyer flew so low the shock waves kicked up waves of dust from the desert floor.

Leaving the course, Greenamyer killed the afterburner, flew out 25 miles, turned around, and seared through again. Sixteen minutes after taking off he'd done it four times, burned 1,000 gallons of fuel, and buried the absolute low-altitude speed record, 902 mph, that was set in 1961 by a U.S. Navy F4H Phantom II. Greenamyer's

988-mph mark remains unbroken.

He intended the speed record to be merely a warm-up, an inspirational teaser to garner sponsorship to break the jet engine altitude record of 123,524 feet, held by a modified Russian MiG-25. But one day in 1978 after a test flight over Mojave, California, his landing gear wouldn't lock in place. There was nothing he could do. With wingtips mere inches from the ground and the fuel system running underneath the fuselage, to belly-land an F-104 is to risk fire or rollover. The manual recommends ejecting. Greenamyer climbed to 10,000 feet, then pulled the ejection handle, and his one-of-a-kind F-104 with the velvet-upholstered instrument panel crashed below him in the high desert.

Over the next 15 years he wheeled and dealt aircraft, often warbirds and surplus transports, culminating in a 1995 attempt to fly an abandoned B-29 off the tundra of northern Greenland. The aircraft was destroyed in a fire and Greenamyer was criticized, as much for failing to clean up the site as for losing a historical treasure. In 1998, as the controversy waned, he looked for an airplane to buy and gravitated to the high performance of experimental homebuilts. At Reno in 1999, he saw Morss zip around the course and checked out Lancair's newest airplane, the two-seat Legacy 2000, the prototype of which was displayed at the races. He was smitten with the airplane, which was as different from a Cessna as a Porsche is from a Ford Escort. "I walked up to the booth and said, 'I want to buy one.'" The first kit hadn't even been delivered, but Legacies were selling like Big Macs—there was already an 18-month backup. "You'll be down the line," the saleswoman informed him.

"How about if I race it for you?" Greenamyer said.

"Who the hell are you?" she said.

The rest, of course, is history, and Reno is now just a month away. Competition in the Sport class hasn't been as intense as it might be. Despite Lee Behel's hope that the manufacturers would get into an all-out sponsorship and equipment war, Continental and Lancair—and Dave Morss—have been



way ahead of everyone else. Winning, Morss admits, didn't even require him to use full power on his factory-tuned engine. And this season, Morss will remain the only wholly factory-supported racer in the class. He should be unbeatable. But Darryl Greenamyer doesn't like to lose.

"From early on there have always been a lot of guys who come to Reno to have fun," he says one afternoon at the Lancair factory in Oregon, where he and former composite surfboard wizard Andy Chiavetta are working on getting the first production Legacy to Greenamyer's shop in California for completion, "but I always raced to win. I don't have a lot of time to prepare, I won't have Morss' Banshee engine, and truthfully, I don't know if I can do it.

*The secrecy that cloaked the development of the Legacy made it seem a civil version of a military "black airplane," but after trying its wings at its home airport in Redmond, Oregon, it will show its mettle in Reno's new Sport class.*

It's been 23 years since I raced. But I don't intend to place second."

Greenamyer heads for the showroom to take a look at the Legacy prototype, where he finds Orin Riddell, Lancair's sales manager, examining the prototype's engine after a short test flight. "How can I go about getting an engine mount that gives me three extra inches [between the propeller and the engine]?" Greenamyer asks.

Riddell looks puzzled. "The prop is already way out," he says. "Is it just for the center of gravity?" (Installing a six-cylinder engine, rather than the standard four-cylinder, will affect the airplane's center of gravity.)

"No," says Greenamyer with a big grin, "I have ulterior motives. Well, can I do it?"

Riddell looks incredulous. "The plane already handles beautifully," he says,



ILLUSTRATION BY HARRY WHITVER

The Lancair IV, which has won the Sport Class race at Reno two years running, is a four-seat composite kit-built aircraft with retractable gear, a three-blade, constant-speed propeller, and a 350-horsepower Teledyne/Continental turbocharged engine. Cruise speed is 335 mph, with a range of 1,450 miles. The IV-P model is pressurized, with a service ceiling of 29,000 feet.





subtly changing the subject. "She's a real glove and with that six-cylinder, it'll be great!"

With a race to win, Greenamyre is determined. "Getting back to my question, how can I get an engine mount built that gives me three inches extra?" After a few minutes it's clear: If Greenamyre wants to get three extra inches in which to work his wizardry, he'll have to do it himself.

As the fuselage and wings slowly come together at Lancair, the gears in Greenamyre's mind whirl. Airframe speed limits? Lancair weight and balance calculations? Greenamyre throws them out the window. If he's going to nose past Morss' winning 319 mph, he'll have to modify the Legacy, and when you add a big propeller, reduction gearing, and turbochargers, the weight and balance change drastically, as do flight characteristics. Greenamyre will be writing the manual for the modified

Legacy, so to speak, which is the case with every pilot flying a heavily modified racer.

The Lancair IV Morss has won with twice now is a four-seat airplane; Greenamyre's Legacy, a two-seat, will be substantially smaller, with less weight and drag. Morss raced with a 75-inch-diameter three-blade propeller. Lancair says the biggest that can be mounted on the Legacy is 72 inches. Greenamyre measures and says it will take 75 inches; the next day he convinces Hartzell to sell him the same custom propeller Morss has. He'll have a stock Continental IO-550 engine, not Morss' factory-prepared Banshee version, but he's thinking turbocharging, titanium rods, cut-down pistons, and water-alcohol injection. "Then she'll buzz," he muses. He'll carefully control the airflow inside the cowling just as he did in his Bearcat. "Thirty percent of a racer's drag is from the cooling system,"

he explains, pondering the air intakes at the nose of the Legacy. "You get all these high-pressure zones within the cowling."

The big question remains how fast a Legacy can go before it comes apart. The brochure lists a speed of 280 mph at 24,000 feet and just 250 at 12,000. But that's with a standard four-cylinder engine. "The Lancair aerodynamicist says it will go as fast as the IV on 100 horsepower less," Greenamyre says. "Apparently they brought in German engineers to figure out the flutter and they rated it to .5 Mach. But I want to go faster than that, so I need to know why they stopped there. Was it all they needed, or did it actually start to flutter and, if so, what part? I think that .5 was just an arbitrary number; I think they have no idea how fast their planes will go. They just assign a number that looks good and safe. I've seen the test data and they don't go beyond it, but that's what we did every day at Lockheed." More than that, they created the data. "Except," he says, grinning, "we had an ejection seat."

Ultimately, of course, even if he isn't quite as fast as Morss, there's the matter of racing skill. "Down the straights, it all comes down to horsepower," Greenamyre says the next day, tying the featherweight carbon-fiber fuselage onto the roof of his \$200 Oldsmobile Toronado to move it from Lancair's mold shop to the main hangar, where the wings will be attached. "But a lot is the guy who flies it, and Morss' course is always way high. No," he says, shaking his head and starting the Toronado up with a screwdriver, "Lancair doesn't know what their plane is capable of and they don't know me."

Will the Sport class and Greenamyre's entry into it transform Reno? "The class' success depends upon pilots being aggressive and selling themselves and their class, which Darryl was always good at," says Bill Eck, chairman of the Reno Air Racing Association. "The crowd loved him. They knew that when he climbed in the cockpit, he was going to go as fast as he could to win, and his entry means a real name running in the class."

"Yes and no," says Jon Sharp. "I can tell you that 400 mph is reachable with-



*The Legacy breezed through all phases of certification testing, including a wing stress test, but when Greenamyre (below) makes all the speed mods he needs to win, in effect he'll be writing the manual, like every pilot flying a heavily modified racer.*







RICHARD VANDER MEULEN

*The Sport class is not as fast or as sexy as the Unlimited, but the aircraft are far more accessible. Kitplanes like the Thunder Mustang and the Lancair IV are within the financial reach of the slightly-above-average Joe.*

out much effort. Morss went 335 using 600 horsepower in a four-seat Lancair; take a plane half that size and add a bit more horsepower and you've got a rocket. I think you'll see the Unlimiteds be refined back to stock warbirds, and the Sport class airplanes will be faster."

Greenamyre may be an Unlimited legend from the past, but Sharp is as current as they come, an engineer at

the Skunk Works whose Formula One *Nemesis* remained as unbeatable in 1999 as it did in 1991. And, Sharp announced last April, not only was he retiring *Nemesis*, he was designing a production kit airplane and moving up to the Sport class in 2001. "The Unlimiteds and the Formula Ones just have such a narrow field from which to draw—there are probably about 50 Formula One racers in the whole country—and there are probably 5,000 kit airplanes out there," he says, "and everyone's trying to figure out how to go faster."

"Sponsorship makes it or breaks it. To take it to the next level, you need industry support, and that's already happening. Our sponsors are invigo-

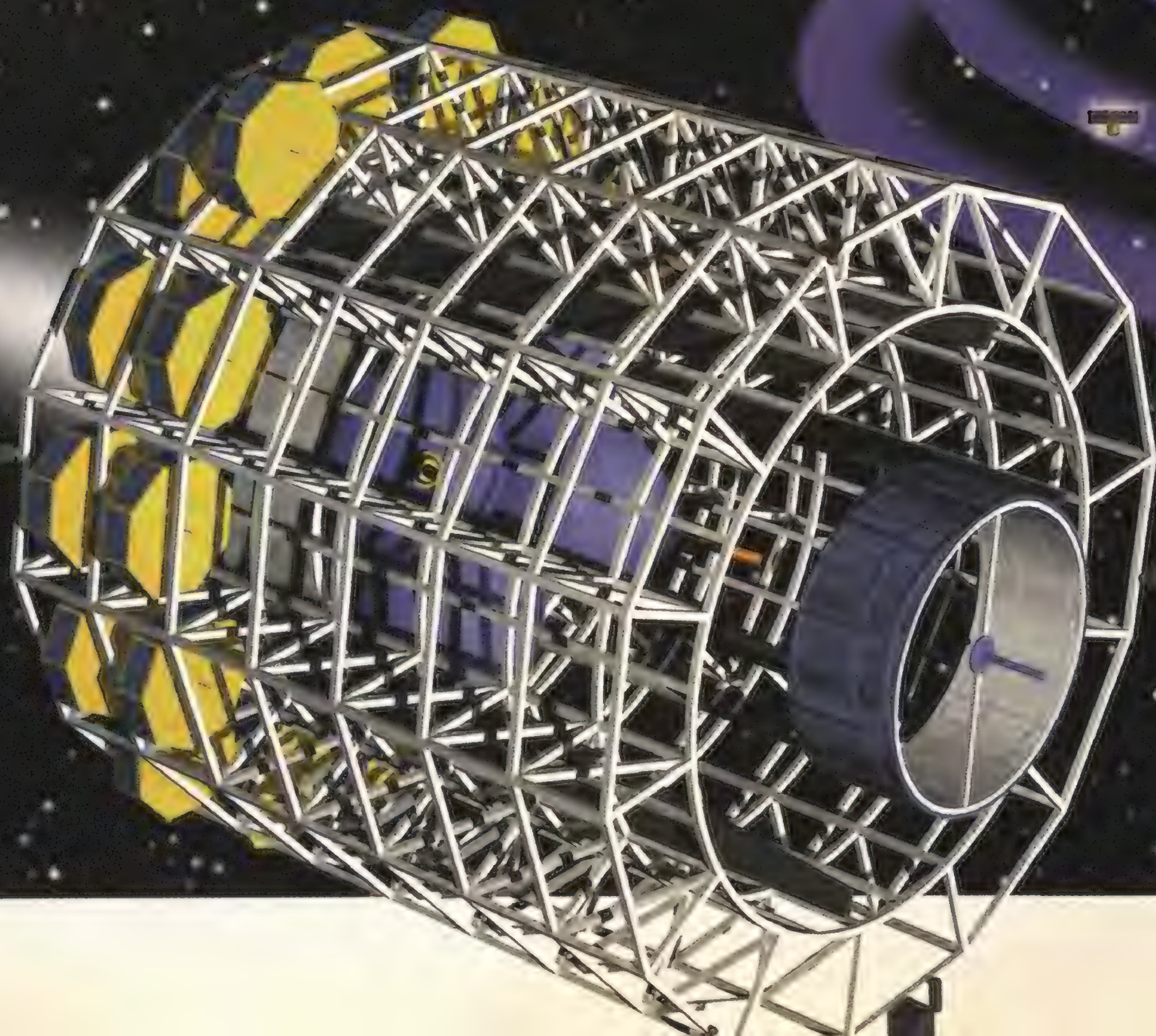
rated and excited, and just in the last few days we've gotten calls from people wanting to put on a Sport class race—I see nothing that could stop a Sport class circuit. I see this as a potential Winston Cup-NASCAR in the air. From the performance and the business side, all things point to the Sport class."

Whatever happens down the road, there's still the 2000 race between Dave Morss and Darryl Greenamyre. Who's going to win? "I don't care," says Lancair's Bob Fair, "as long as it's either one." Morss, of course, isn't so neutral. "Darryl is an extremely innovative guy and will be flying a much smaller plane than me," he says. "But it'll be fun to beat a legend." ➔



# SWARM

The newest satellites are small, they're clever, and they travel in packs.







by Ben Iannotta Illustrations by John MacNeill

Program manager Randy Kahn glances into the window of a clean room at Kirtland Air Force Base in the New Mexico desert. "We have to hurry," he says, grabbing two white lab coats and hair nets. Kahn is anxious to show off MightySat 2.1, a \$15 million experimental Air Force satellite that is about the size and shape of a microwave oven. It sits on an aluminum table, enduring a system-wide check in anticipation of its upcoming launch into space atop a small Air Force Minotaur rocket. Kahn is rushing because in 800 seconds technicians will switch the lights off to simulate the craft crossing into Earth's shadow.

Engineers have packed MightySat with experimental military technologies, like a hyperspectral imager that can dice reflected sunlight into 256 bands. But it is a last-minute addition to the satellite's manifest that is getting the most attention. MightySat, itself a welterweight at 266 pounds, will carry two much smaller passengers, referred to by their creators as picosats. At 10 ounces each, they are the smallest operational satellites ever sent to orbit.

Kahn points to a rectangular slot cut into MightySat's charcoal gray composite underside. Very soon, engineers will place the picosats into a spring-loaded aluminum canister and slide the assembly into this slot, which is about big enough for a videotape. Toward the end of MightySat's year-long mission, a trap door will open and eject the two picosats like Pez candies.

Once they're on their own, the little satellites will tumble away, tethered to each other by 100 feet of polyethylene and gold line. They will then repeat operations performed by two tiny predecessors on the first picosat test flight last February. On that mission, the first to demonstrate the principles of releasing miniature satellites from a mothership, the two picosats transmitted signals to Earth and received simple commands from ground controllers. On this mission, if controllers are lucky, the pair will also pass signals between each other, something they were unable to do last February because they ran out of battery power. That demonstration will lead eventually to a new class of spacecraft.

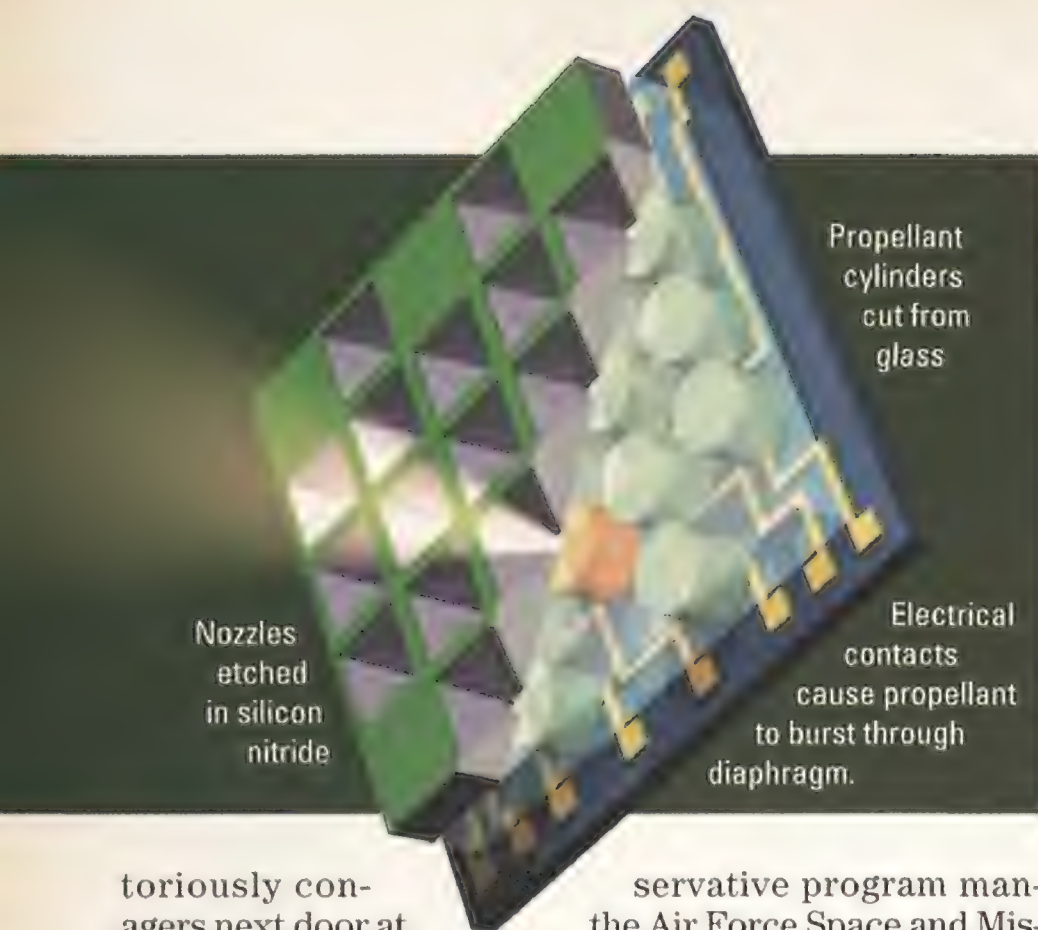
### **You Say You Want a Revolution...**

In his office at the Aerospace Corporation in El Segundo, California, picosat program manager Ernie Robinson leans forward and peers over his plastic-frame glasses. "This is the start of an interesting whole new world," he says. "We're using the same philosophy that Iridium tried in the communications business." Instead of serving a vast number of users with a single giant communications satellite, Iridium launched a network of 66 small satellites that could pass along signals from one satellite to the next (see "The Last Satellite," In the Museum, p. 14). "The business failed but the philosophy is sound: a lot of elements close to Earth instead of a few far from Earth," says Robinson. "You can afford to lose a few and still have widespread functionality."

As a federally funded research and engineering center, the Aerospace Corporation acts as an alter ego for the no-

*Technologies emerging today will one day enable NASA to send a hundred satellites into Earth's magnetotail.*





*Using manufacturing techniques from the computer chip industry, engineers built thrusters out of silicon.*

launch those spacecraft in 2008 or 2010 under a project called Magnetotail Constellation DRACO. ("DRACO" is a play on the star constellation by that name and stands for Dynamics Reconnection and Configuration Observatory.) But as a preliminary step to shrinking satellites, NASA will launch in 2003 three octagonal satellites of about 44 pounds each under a project called Nanosat Constellation Trailblazer. Teams at NASA's Jet Propulsion Laboratory in Pasadena, California, and at the Goddard Space Flight Center in Greenbelt, Maryland, are designing the satellites to test technologies that will be required for miniaturizing many of the systems necessary for any spacecraft to function: thermal control, communications, attitude and positioning control, propulsion, and power production and distribution.

### **Itsy Bitsy Means Cheap**

Eventually constellations of nanosatellites could save billions of dollars in launch costs by replacing some hugely expensive military, reconnaissance, and commercial communications satellites. The Pentagon pays about \$350 million for a Titan 4 rocket to launch a single spy satellite. At best, that works out to \$10,000 a pound. "If you buy a computer at the store and it costs \$10,000 a pound to bring it home, you will end up buying something like a Palm Pilot or smaller," says Siegfried Janson, a senior scientist at the Aerospace Corporation's Center for Microtechnology and one of the revolutionaries teamed with Robinson. "That's what we're working on. We're trying to deliver the satellite equivalent of the Palm Pilot."

Janson, 44, was born in Hamburg and moved to the United States with his parents as an infant. His first job was dispensing soft ice cream at his father's Dairy Queen. "It was my first exposure to fluid mechanics," he quips.

The third revolutionary is Henry Helvajian, 46, an expert in exotic materials who exudes bookish enthusiasm when the topic turns to nanosats. Ask him about Janson and it's like talking to Wilbur about Orville or Watson about Crick. He says he and the soft-spoken Janson had to figure out how to win over skeptics who in the early 1990s thought the pair's ideas for tiny satellites were a little nuts.

"Siegfried had to invent words to get the idea across," Helvajian says. According to Helvajian and Robinson, it was Janson who coined the term "nanosatellite"—in the title for a 1993 paper, "The Concept of 'Nanosatellite' for Revolutionary Low Cost Space Systems," presented at the 44th International Astronautical Federation Congress.

"Nano" is the Latin prefix for billionth, and a true nanosatellite should weigh a fraction of a pound, but you will find satellites many times that size claiming the title. "Pico" is the Latin prefix for trillionth. Robinson's picosats are not really a trillionth of anything, but the name drives home the point that they are small. "People try to come up with names that are sexy. That's how you end up with picosats that weigh more than nanosatellites," explains Janson. He classifies miniature satellites according to his own informal scheme: A microsat is what an adult male can lift, a nanosat

toriously con-  
agers next door at  
sile Systems Center  
the Air Force Space and Mis-  
servative program man-  
the Air Force Space and Mis-  
and across the country at the  
U.S. National Reconnaissance Office. Robinson has been  
at the corporation for 23 years, long enough to have earned  
the title "distinguished engineer," and has worked in mate-  
rials, structures, boosters, upper stages, space propulsion—  
he's done it all. And even at the Aerospace Corporation,  
where brainy engineers in beards and blue jeans hatch fu-  
turistic ideas for improving Air Force satellites and weapons,  
he has a reputation for championing the far out.

Robinson and two colleagues—he says the trio reminds him of Bertram Wolfe's book *Three Who Made a Revolution*, about Lenin, Trotsky, and Stalin—helped start the corporation's Center for Microtechnology in 1998. They believe their work will change the way satellites are manufactured and launched. Today, even small satellites tend to be multimillion-dollar works of art, hand-built by engineers in white "bunny suits." Robinson is working toward the day when constellations of miniature satellites will be mass-produced like computer chips.

### **This Could Be the Start of Something Small**

Robinson's picosats are the first miniature satellites to reach orbit under a new U.S. research push toward miniature technologies, or nanotechnologies. Two years ago, the U.S. Department of Defense started the University Nanosatellite Program, which funds teams at 10 U.S. universities experimenting with miniature satellites and brainstorming their applications. The Defense Advanced Research Projects Agency contributed \$535,000 to the Aerospace Corporation for the picosat program. And the Clinton administration plans to spend \$495 million—an 83 percent spending jump—on a host of nanotechnologies in 2001, spreading money among agencies from NASA to the National Institutes of Health.

NASA's plans for nanosats are aimed toward the audacious goal of sending a swarm of 50 to 100 satellites, each weighing less than 22 pounds, to monitor Earth's magnetotail, like so many weather balloons. The nanosats could warn other satellites of solar storms and dangerous swirls of electrified plasma in Earth's wake. Scientists hope to



is what you can lift with one hand, and a picosat is something you can throw down the hall.

"It's a humorous situation of a bunch of grown men standing around arguing who's the smallest," chuckles senior scientist Harlan Spence, an aerospace engineer at Boston University, one of 10 in the DOD's University Nanosatellite Program.

Shrinking a satellite to picosat size seems not to be the tough part of the problem. There is no doubt miniature satellites can be built, says Rick Fleeter of AeroAstro in Herndon, Virginia, a leading manufacturer of small satellites. "The real question," says Fleeter, "is 'What can they do that's interesting?'"

Janson and Helvajian are inventing nanotechnologies that will one day allow picosats to do some very interesting things. They have studied the processes of the silicon microchip industry and borrowed a few tricks from engineers working on microelectromechanical systems, or MEMS (see "Microspies," Apr./May 2000). They have learned how to capitalize on the physical properties of silicon to make miniature satellite systems that act like—even if they don't look like—their full-size counterparts. Being revolutionaries, they started with propulsion.

### Nanonozzles

Using a programmable laser, they drew small boxes on the super-thin silicon nitride coating on silicon chips. They soaked the chips in potassium hydroxide to etch away the exposed silicon along predictable angular planes. The results were hollow, inverted pyramids that made pretty good rocket nozzles (see illustration, opposite page). Since the reverse sides of the chips were also coated with etch-proof silicon nitride, the "intake" of each nozzle would be covered by a diaphragm of silicon nitride 200 times thinner than a human hair.

They then glued the chips onto matching pieces of glass with cylinders cut in the glass to hold rocket fuel. To this double-layer structure they glued another layer of silicon with tiny electrical pathways that would carry current to an igniter attached to each cylinder. One of the first fuels Janson chose was paradichlorobenzene, the substance in mothballs. The heated fuel vaporizes and bursts the diaphragms, generating thrust. Janson calls them "digital" thrusters. They have no throttle; they are either off or on.

His thrusters flew on the space shuttle *Columbia* last July as part of an experimental package of MEMS devices. For safety reasons, they were loaded with water and Janson was not allowed to fire them. The point of the experiment was to find whether the delicate structures would survive the gravitational and other forces of the ride intact. "They're sitting on my desk right now," Janson says. "The diaphragms didn't burst. Nothing broke." Janson and Helvajian have learned how to etch up to 15 nozzles onto a single chip.

Of course, the satellites will need to know where they are in space in order to know in what combination to fire

the thrusters. Conventional satellites rely on the changing angle of a spinning mass to determine their attitude. These gyroscopes often work in tandem with Earth sensors, which measure Earth's limb against the cold backdrop of space, or sun sensors that measure the angle of sunlight, or star sensors, which determine location relative to a star pattern.

"It's possible to create microelectromechanical versions of all those," Janson says. Some are as small as Lincoln's nose on a penny, "but in many cases, the accuracy isn't as good as the big guy," he says. "Yet."

With MEMS such as these, Janson and Helvajian think their satellites can be launched into space by the hundreds or even thousands. "We see the future of satellites as silicon wafers made in different places and fused together," says Janson. "They will be hockey puck size." With the right breakthroughs in microthrusters, power supply systems, and miniature attitude control devices, these satellites could fly together in a network acting as a single transmitter and receiver.

One of the prospective customers for such an array is the super-secretive U.S. National Reconnaissance Office, which builds and flies spy satellites. This means Janson and Helvajian have a hard time saying exactly which of today's satellites they might replace, but they can explain in general terms the advantages of such a huge array.

Over the years, observers have gleaned that some of the NRO's spacecraft are essentially Hubble Space Telescopes with their magnifying mirrors pointed Earthward. Others function as giant ears in the sky that try to intercept electronic communications and signals. The larger the aperture—the diameter of the mirror or com-dish—the tighter the spacecraft's focus on Earth. This is why spy satellites are launched on the huge Titan 4, whose payload shroud can be up to 86 feet

*A nanosat at the center of the Solar Blade Heliogyro, designed to unfold once in orbit, could broadcast storm warnings as the rotors ride the solar wind.*





long. You could attach an upper stage to a school bus and launch it on this rocket.

But even with the Titan, there is a limit to the size of a fixed, rigid antenna or mirror that can be built and launched. An array of nanosatellites, on the other hand, all receiving and transmitting signals and hopping them along one to the other, could be miles across.

So a nanosat array could become a far superior listening device? "Now you're getting close to where we can't say anything," Janson warns.

To understand how a large array works, think of two stars that are close together in the night sky, Janson says. For either optical or radio receivers—the stars emit energy in both ranges of the electromagnetic spectrum—it is the diameter of your receiver that determines whether you can discern the stars as two separate objects. If the receiver is too small, the signals will look like one star. For example, if a receiver of a given diameter can detect stars no closer together than a half degree, engineers say the angular resolution of this receiver is a half degree. To "resolve" stars closer together than that, you'd need a larger receiver.

Aerospace Corporation engineers are trained not to talk in terms of spy satellites, yet discerning two signal sources close together on the ground is very much what intelligence officials are trying to do with these spacecraft. "Is the terrorist transmitting from this house or that house?" analysts might ask. The goal is to eavesdrop or take photos of particular hot spots on the globe. For decades, this requirement has forced engineers to build bigger and bigger satellite dishes or mirrors—in other words, bigger eyes and ears. And this is where the swarms of nanosatellites come in. Each nanosatellite would have its own mirror or antenna to gather signals. The full constellation could resolve signals from an area on the ground, according to Janson, as small as three square miles.

### Building a Smaller Mousetrap

What started as a clique of nanosat wonks trading research papers in near obscurity has grown into a major trend. "Ten years ago I was considered part of the lunatic fringe," says Janson. "Two years ago, someone looked me straight in the eye and said, 'That's conventional technology.'"

Like Janson and Helvajian's focused research, some projects in the University Nanosatellite Program aim to improve services already being provided by conventional satellites. Arizona State University in Tempe, New Mexico State University in Las Cruces, and the University of Colorado in Boulder are building three identical hexagonal-shaped satellites that will photograph billowing thunderheads from slightly different angles to generate three-dimensional stereo images. Single Earth-observing satellites have created stereo images by photographing cloud formations from different points along the orbital track. But creating three images at the same instant (from different locations) improves the coverage of such quickly changing phenomena as clouds. So the students have found another application for satellites flying in formation, since the three satellites must operate as a network to target and acquire images. An added challenge is that each of the satellites in the network must



*NASA's Nanosat Constellation Trailblazer is a technology demonstrator focused on formation flying.*

weigh less than 33 pounds. The mass limit is a strict condition of flying on the space shuttle. The Three-Corner Sat, as the students call the mission, could be launched from the shuttle as early as May 2002.

Several other university programs are trying to prove technologies needed for satellites to fly in formation, work also being investigated by NASA in its Nanosat Constellation Trailblazer program. The trail being blazed will lead ultimately to a summit in NASA's Origins program: the Terrestrial Planet Finder. Stationed 93 million miles from Earth, as far from the Earth as the sun, the five-telescope interferometer will, as its name implies, seek planets like our own in other solar systems. The interferometer will work only if spacecraft designers have discovered, by its projected 2011 launch, how to maintain the relative positions of the Planet Finder's five spacecraft with such tight tolerances that the array will seem connected by a virtual truss (see illustration, opposite page). Each of the Planet Finder's spacecraft will weigh almost 2,000 pounds, so benefits of formation-flying research done for nanosats will be a case of the little guys teaching the big guys a thing or two.

### Solitaire

Not every nanosat needs company to do its job. Harlan Spence and his students at Boston University are building one that will fly solo. Their Constellation Pathfinder (not to be confused with NASA's Constellation Trailblazer) is the only one of the university studies driven by a scientific goal, rather than an engineering one. The tiny Pathfinder, weighing a hair more than two pounds, will carry into space a tiny magnetometer to measure the magnetic fields in Earth's ionosphere. "We're trying to measure extremely weak fields," says Spence. "So we have a puny little satellite with a big boom [the magnetometer]. It looks like a squash racket."



By taking simple magnetic measurements, Spence hopes to pave the way for a fleet of hundreds of nanosats—similar to NASA's Magnetotail Constellation DRACO but deployed throughout the magnetosphere—that will help space physicists understand the mechanics of space weather.

Richard Blomquist, an engineer at Carnegie Mellon University in Pittsburgh, doesn't much care about formation flying techniques either. He wants to park a windmill-like solar sail between Earth and the sun. His four-propeller Solar Blade Heliogyro Nanosatellite would demonstrate a way to hover a tiny satellite out in space as an alarm bell for solar storms, which bombard Earth with subatomic particles that can short out satellites and even electrical utilities. His slowly whirling solar blades would ride the outward flow of photons like a kite in the wind.

Nanosatellite technology is critical to his plan because the less mass is at the center of his blades, the shorter they

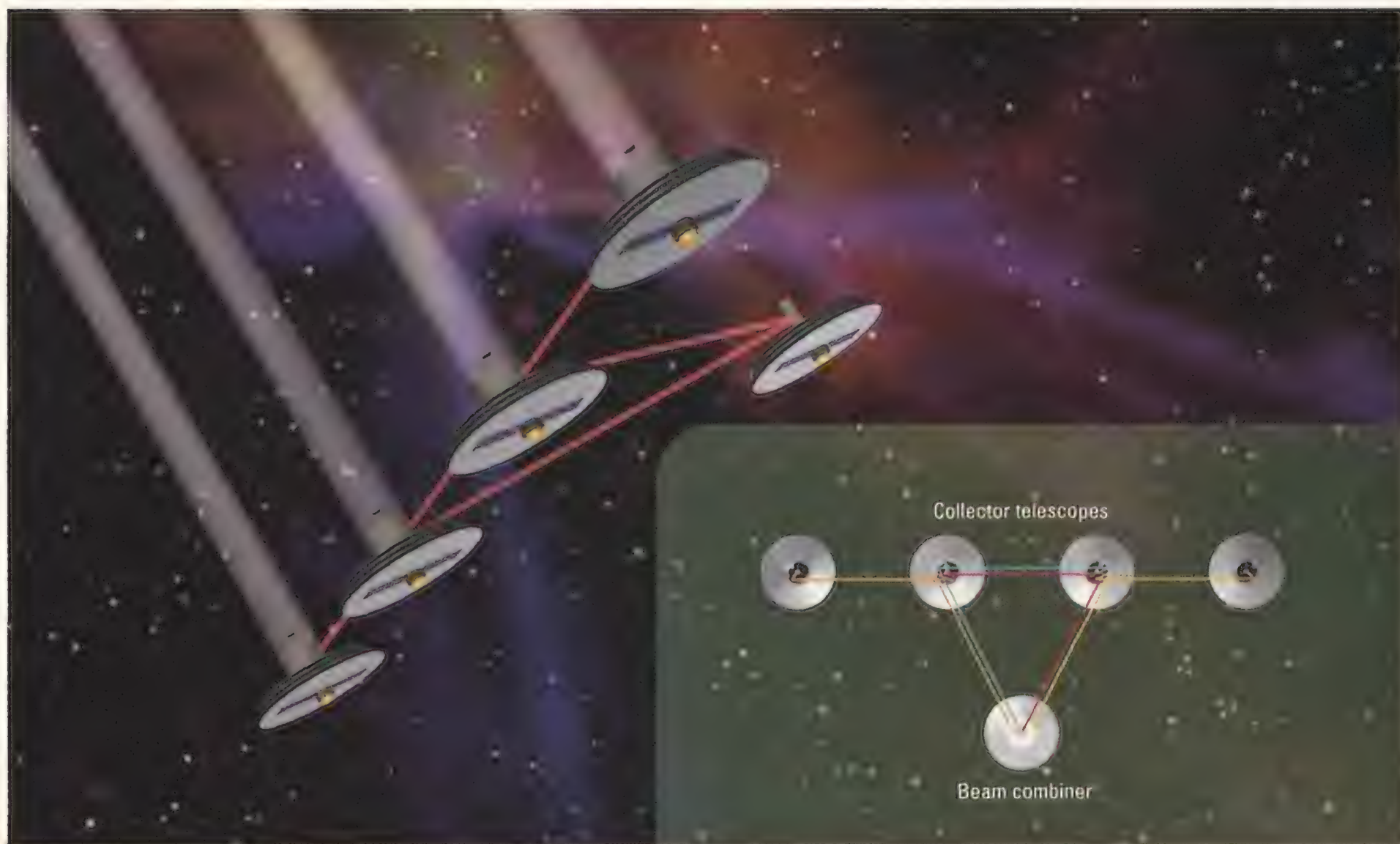
*To gain the ultrafine resolution necessary to view Earth-like planets in other solar systems, NASA will orbit a five-spacecraft interferometer, an instrument comprising four telescopes that transmit collected light to a beam combiner spacecraft. This process achieves the same resolution as a single telescope with an immense aperture—one equal to the distance between the most widely separated telescopes in the system; in this case, up to 3,000 feet. But the programmed optics of interferometry will be successful only if the spacecraft in the system are rigidly controlled as a formation.*

can be. "Solar sail designs over the decades were thought of as these amazing, giant spacecraft," Blomquist told the trade weekly *Space News*. "But now, with the ability to make spacecraft small, the size of solar sails no longer scares people. Microdevices and miniaturized electronics is one of the big enabling technologies that make solar sails much more viable."

The nanosat revolution is reaching beyond the technology development programs to affect other practices in the aerospace industry. "We're creating a force to improve the way we launch," says Robinson. Frustrated by the delays associated with conventional launches ("In this business, you attend many more aborts than you do launches," he says), he has a photograph on his office wall of the giant gun built by the late Gerald Bull, the infamous engineer from Montreal who was allegedly assassinated by Israeli agents for helping Saddam Hussein build a supergun. Robinson wants to use a supergun to launch nanosats.

It's easy to get caught up in the enthusiasm for nanosatellites. The applications are inventive; the technologies, far-reaching. But it's also wise to listen to Ernie Robinson. "No one of these missions is going to be a huge flash of technical accomplishment," he says of his own project. "But every one is going to be a small, steady step that adds a rung to our ladder."

The picosats carried aboard MightySat 2.1 last month are made of aluminum, not silicon. They have no propulsion, no attitude sensors. And they don't have much power in their tiny batteries. But hey—neither did Sputnik. ➔





# Special

## 60 and Out

**The FAA says it's not safe to let older airline pilots fly. Now a group of pilots is challenging that rule. Which side has the stronger case?**

The harshest reality of being an airline pilot in the United States is that on your 60th birthday, you're finished. Grounded. Gone mall-walking. You will never again pilot a passenger-carrying airliner, for on that day, Federal Aviation Regulations demand that you retire.

You can continue flying as a flight engineer, if you can find an airplane that still requires one. You can ride in the jump seat as a check airman, watching pilots do the job you once did. You can teach procedures in simulators, pretending to be a pilot. Or you can become a freight dog, flying unscheduled transports late at night, since the Federal Aviation Administration doesn't care as much about the safety of a load of car bumpers as it does about a cabin full of warm bodies.

Did I say "safety"?

Well, isn't that what the rule is all about? Pilots slumping over the yoke from a stroke, dropping dead of a heart attack during a bout with clear-air turbulence, lapsing into an Alzheimerish fog on final? That's what the FAA has been claiming since it established the rule in 1959.

But in fact, there is no evidence whatsoever that pilots 60 and over are more dangerous at the controls than younger colleagues. That, anyway, is the position taken by the Professional Pilots Federation, an organization formed to get the rule overturned. The group points out that the rule originated not with physicians or medical researchers but with the airlines, several of which instituted an age-60 retirement rule in the early 1950s. When they were challenged by the pilot unions, the airlines lobbied the FAA to make the age limit a law. The PPF also points out that when the FAA agreed to do so, it had no hard data

to justify its decision. A letter written by the agency administrator who established the rule, Elwood Quesada, reads in part: "Although there exists at present no scientific evidence that airline piloting...becomes critically unsafe at any given age, nevertheless it can be said that such activities do undoubtedly become less safe with increasing age beyond some ill defined point."

In April, the PPF petitioned the FAA to begin granting individual airline pilots exemptions from the age-60 rule, based on the results of their medical tests. The group argues that "advances in medicine and testing have rendered obsolete the rationale for the age-60 rule as applied to [the] petitioners."

So far, the FAA has not responded. When the agency last considered amending the rule, five years ago, it declared: "The FAA's overriding regulatory concern is safety. Before [changing] a regulation, the FAA must be satisfied that it will maintain or raise the current level of safety." Evidently, the agency wasn't satisfied.

Other groups and individuals have periodically challenged the rule, using various legal strategies. Though the 1987 Age Discrimination in Employment Act prevents employers in virtually every other industry from forcibly retiring anyone on the basis of age, the law apparently can't defeat the age-60 rule. In various lawsuits, several Federal appeals courts have

upheld the FAA's contention that its safety concerns carry more weight than anti-discrimination legislation.

But most scientists familiar with the issue disagree with the FAA. "There is absolutely no scientific basis for a retirement rule based on age," says epidemiologist Gouhua Li of the Johns Hopkins School of Medicine, who since 1987 has been researching the medical, accident, and violations records of 3,000 commuter-airline pilots. His study, funded by the federal National Institute on Aging, chose commuter pilots because they had long been allowed to fly past age 60 (this year, the commuter rule was changed to bring it into accordance with large-airline standards). The pilots that Li began following when they were ages 48 to

ERIC LONG





# Report

54 are today 61 to 67. "The evidence that has been accumulating in the last five or six years shows that age-related differences in performance are very small," Li says.

"There is no data to show that at age 60 there begins any massive decline in performance," says Pamela Tsang, a psychologist at Wright State University in Dayton, Ohio, who is studying the ability of pilots and others to perform multiple tasks simultaneously. "There are a lot of individual differences in the way people age, and the changes [over time] are very subtle," she says. "A lot of aging studies are showing similar trends, and you don't even see these individual differences until people are way beyond 60."

In fact, a 1993 study conducted by the FAA's Civil Aeromedical Institute found that as pilots neared 60, their accident rate actually turned slightly downward. The institute concluded that the FAA's rigorous medical testing, which airline pilots must undergo every six months, apparently weeds out pilots likely to be involved in age-related accidents before they ever reach 60. FAA higher-ups rejected the results, calling the research "crude." (The study had analyzed all accidents, regardless of cause, and included private pilots as well as professionals.)

"What has to be done is some long-term research," says David NewMeyer, department chair of the Aviation Management and Flight program at Southern Illinois University. "If there is going to be an upward move in the age limit, it needs to be supported by a preponderance of evidence that everybody is still sharp at that age."

In 1978, gerontologist Robert Butler, the founding director of the National Institute on Aging, tried to undertake just such research. He and his colleagues had been tasked by Congress with studying the effects of aging on pilots but

"could not scientifically answer the question of whether 60 was justified," he explains today, "because there were no airline pilots who had been allowed to fly past 60. We recommended to the FAA, after bringing in teams of experts—human-factors scientists, psychologists, cardiovascular experts—that they allow pilots who volunteered to do so to begin to be tested at age 58 and that they keep flying until 65 on the basis of rigorous annual tests. The FAA never took us up on that suggestion, even though it came from the National Institutes of Health."

**In one study, as pilots  
approached 60, their accident  
rate actually went down.**

Butler, who is now president and CEO of the International Longevity Center, a non-profit research and education organization, says there is no question that reaction time increases with age, but adds: "Whether it's enough to really matter is something else again. And a lot of the [aircraft] technology we have today may compensate for even these minimal changes. Healthy older people also have accumulated more knowledge, more information, a larger vocabulary than younger people. In certain cognitive spheres, older people actually do better, even in their 70s and 80s."

How about the ability to cope with cockpit stress? "There's not much evidence to suggest that older people can't handle stress," Butler says. "In fact, it's possible that those individuals who can handle stress pretty well are the ones who survive longer. It could be that people who do not han-

dle stress well are dead by the time they're 60."

If the rule has no scientific validity, what's made it so invulnerable? "There are many interest groups with different agendas in mind, many of them economic," says Hopkins' Li.

Let's look at these groups.

The airlines: You're a bean counter trying to get another buck out of each flight mile, and suddenly you're presented with the spectre of hundreds of \$200,000-a-year senior captains being allowed to fly another two, three, or five years. If it were up to you, you'd make it the age-50 rule.

The pilots: Most young and middle-aged airline pilots think the age-60 rule is a splendid broom to sweep out the seniority list.

The pilot unions: Most are concerned with keeping their younger members happy (see above) and also vigorously oppose any increasingly intrusive medical testing. Such testing would be inevitable if the age barrier were raised, since over-60 pilots would, at least initially, be under a medical microscope.

The flying public: Certainly we respect the experience and judgment of older pilots, but it's hard to imagine a majority of the public demanding that airliners be entrusted to increasingly elderly captains.

Lastly, and perhaps most importantly, there's the FAA. In the basest political terms, the agency has had no incentive to change the rule. Think about it: Would you want to be the FAA administrator who changed the rule, then had an airliner fly into the ground on a stormy approach with a 63-year-old in command?

*—Contributing Editor and former private pilot Stephan Wilkinson operates under his own age-63 rule, having voluntarily retired from flying last year.*





## US Tab for D.C. Air Show Fast Soaring Out of Sight

By RICHARD BRADLEE

Sentinel Washington Bureau  
Washington, D. C. — Costs of an international air show that Milwaukee once offered to stage for nothing have soared to \$8 million and the bills are still coming in.

The show has been renamed Transpo 73 and will be staged at the Ronald Reagan Washington National Airport in July.

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en. Proxmire Charge:  
Air Show Pitchmen  
Bilking Taxpayers

WASHINGTON (UPI) — William French, a Senate aide, today charged that the...



# Paris Envy

In the early 1970s, Washington set out to build an American version of the world's premier airshow.

by Roger A. Mola Photo illustrations by Randy Mays



*Looming over Secretary of Transportation John Volpe (far left), FAA Administrator John Shaffer (near left), Vice President Spiro Agnew (below right), and the entire Transpo 72 extravaganza was the ominous presence of Senator William Proxmire (upper left), who maintained a steady barrage of criticism throughout the months leading up to the first U.S. government-sponsored aerospace industry trade show.*

As soon as the helicopter touched down at Washington Dulles International Airport on May 27, 1972, Vice President Spiro Agnew emerged from the cabin and hurried toward a platform before 25,000 guests assembled for the opening ceremonies of the United States International Transportation Exposition—Transpo 72. Agnew began: “I bring greetings from President Nixon. He wanted to be here today, but I think we all agree, the President is entitled to a rest.

“As I look around Transpo 72,” the veep continued, “I am convinced that we are headed in the right direction. All of this will go down in history as a benefit to mankind.” While Agnew spoke, workers were still slapping on the last coats of paint in the exposition hall.

Secretary of Transportation John Volpe was the next speaker. “Putting together a show of this scope is unique for any government agency, indeed for any organization,” he said. Volpe was joined by Transpo special assistant William J. Bird, who puffed, “Our government has taken on a sizeable responsibility for the successful implementation of Transpo 72. A responsibility

to the taxpayer, the wage earner, and those who really want to do something about solving the problems of congestion and [international] balance of payments.” Bird and Volpe stepped aside and a volley of model rockets schussed into the sky.

Behind bleachers crowded with VIPs sat a 12-acre theme area, “Man in Motion,” with more than 700 graphic panels depicting the story of transportation, from the oxcart to the moon shots and beyond. Illustrations of chariots, electric cars, and personal jets decorated the area. Over 100 business centers awaited icy cocktails and warm handshakes. The centers flanked a landscaped canal laced by 22 Bailey bridges erected by the U.S. Army. Flags honored every state and 60 participating countries.

The U.S. Army Golden Knights parachute team floated down. Federal Aviation Administration administrator John C. (Jack) Shaffer had exercised unprecedented authority to get the team, along with members of the United States Parachute Association. With a military flourish, the team presented Spiro Agnew with a baton. Agnew tucked it in his summer suit and departed for the White House.

PHOTOS BETTMANN/CORBIS, NATIONAL ARCHIVES, DEPT. OF TRANSPORTATION, NASM, ARTHUR GIBSON







*Delegates from aviation agencies of visiting nations viewed a model of the show site in Washington.*

Transpo 72 had opened with an awkward panache. By the time it closed eight days later, on June 4, it had become the first air exposition—more accurately, the first total transportation exposition, ever developed, funded, and managed by the federal government—and ultimately, after years of scandal, partisan political clashes, and cost overruns, the last.

The idea of staging a federally sponsored international trade exposition first arose in 1965 within the Interagency Committee on Export Expansion, headed by FAA administrator Najeeb E. Halaby. At the time, two biennial aerospace events dominated the community: Farnborough, a largely British affair, and the Paris Air Show, an international spectacle regarded as the dominant event of its kind. Halaby first envisioned an aerospace and scientific exposition at Dulles International Airport in northern Virginia in the summer of 1966. “Such a show would serve to increase foreign sales of U.S. aerospace products” and “do much for U.S. international prestige,” he wrote to President Lyndon Johnson. For help in pushing his idea, Halaby recruited Chester C. Spurgeon of the FAA Office of International Aviation Affairs, who for years had helped direct the U.S. par-

ticipation at Paris. Together, Halaby and Spurgeon pitched the idea to Johnson. Intending the plan to die of neglect, Johnson sat on the proposal for months until his own nominee for FAA administrator, General William F. McKee, could be confirmed by the Senate.

At the 1967 Paris show, Spurgeon ran into Congressman L. Mendel Rivers of South Carolina, chairman of the House Committee on Armed Services. Spurgeon still clung to the idea of a grand U.S. airshow—and he got Rivers’ attention. Spurgeon argued that without their own showcase on the scale of Paris, U.S. aerospace firms lacked prestige in international markets, costing them sales that would make hardware cheaper for Rivers. Congressman Rivers, who could barely conceal his distaste for French president Charles de Gaulle, sped home, giddy at the thought of upstaging the French.

During the 90th Congress, Rivers introduced a bill authorizing \$5 million to stage an International Aeronautical Exposition. It died, but in the next session, Rivers slipped the measure deep inside a stack of legislation intended for the funding of military construction. From thin air, he inserted the figure \$750,000 for an exposition.

Meanwhile, America had changed presidents and attitudes. On December 5, 1969, Richard M. Nixon signed into law the Military Construction Authorization for 1970, allowing him to establish and conduct an International Aeronautical Exposition with an appropriate emphasis on military aviation at a location of his choice and within two years. Nixon could appoint and fix the compensation of staff as he deemed appropriate without worrying about federal hiring regulations. He could obtain temporary services (not to exceed \$100 per diem) for any individual, charge and collect admission and exhibition fees, accept donations of money, property, or personal services, request the head of any agency to detail personnel with or without reimbursement, even acquire and improve real property. Better yet, the president could “enter and perform with any person or body politic various contracts, leases, and cooperative agreements as deemed appropriate” without regard to any of a long list of

pesky laws. Following the exposition’s close, any acquired land would belong to the Department of Defense. Any net revenues would go to the Treasury as miscellaneous receipts.

Nixon loved the idea, but as Agnew later explained, he had other things on his plate. Nixon’s assistant for domestic affairs, John D. Ehrlichman, wrote the Honorable John Anthony Volpe, asking him to take the ball and run with it. Volpe had been serving his third term as governor of Massachusetts when he was tapped by Nixon to become the nation’s second secretary of transportation. “The President has asked me to inform you that he has decided to delegate to you the responsibility for operation and management of the U.S. International Aeronautical Exposition,” Ehrlichman wrote. The confidential note came six months before the public announcement, giving Volpe a head start.

That July, Nixon signed Executive Order number 11538, formalizing the assignment to Volpe of “[t]he power to exercise without approval, ratification or other action of the President” the authority vested by the act. For convenience, Volpe could also ignore the civil service regs and prevailing rules of procurement.

If the role didn’t suit Volpe, he was free to delegate any and all duties. But it was an election year, and he wanted the visibility. Volpe enlisted the help of the new FAA administrator, Jack Shaffer. They could deliver this expo, but not next year and certainly not for \$750,000. By May, Volpe wrote to the chairmen of the House and Senate Armed Service Committees, Congressman Rivers and Senator John Stennis, respectively. Volpe wanted time and money, and his staff proffered an amendment to the Military Construction Act.

“Delete from the first sentence ‘1971’ and insert in its place ‘1972’ and (2) delete from the last sentence ‘\$750,000’ and insert in its place ‘\$3,000,000,’ ” it read. For three million bucks the American people would get not just airplanes but trucks, trains, buses, and anything else on wheels or rails. The International Aeronautical Exposition was now the U.S. International Transportation Exposition—Transpo 72.



"We don't want to compete with the Paris Air Show to be held in 1971," Volpe wrote to Rivers and Stennis. "The French would undoubtedly construe our holding an exposition in the same year as their own as a deliberate attempt to destroy their show, which is the oldest in the world." Yet in the same letter, it was equally clear that he intended to trump Paris: "Of utmost and urgent importance is the matter of budget," stressed the secretary. "The exposition must be the best of its kind the United States can produce to compare and compete with the Paris Air Show and other similar international events. The Exposition will prove our product superiority."

Congressional approval of the increased funding was at least a year off, but in the meantime, Spurgeon signed contracts for \$160,000 to begin planning and compute cost estimates. Despite the publicly quoted figures, Spurgeon, consultants, and the DOT revised estimates a half dozen times, from \$3 million to over \$9 million.

Rivers' staff relished his pivotal role

and communicated the need for some quality pucker. "The Congressman has no particular thought in mind in regard to the production and organization of the exposition," relayed his staff. "But he wishes to receive the acknowledgment that he is primarily responsible for bringing the event into reality." Volpe and Shaffer paid him a visit.

Eventually Congress authorized \$5 million, with the rest to be raised from admissions and exhibits. But the funds would cover only publicly reported amounts. Agencies were cajoled to follow the presidential mandate to come forward with cash and cooperation, all off budget. Dozens of sites were considered, but finally the new but remote Dulles airport was chosen, partly because so few travelers used it; perhaps the publicity would boost traffic.

Patterned after the Paris show, Transpo was not exactly by and for the people. "The public will be given all reasonable consideration," the DOT plan conceded, "but their admission will be limited to afternoons or weekends when their presence will offer the least interference with

the conduct of business between exhibitor and potential customers."

Finance and logistics were staggeringly complex, yet the bluster centered on process and administration. Where should the bureaucrats be located? Which office gets to spend the money, who gets the credit, and who takes the blame? More important, Transpo could provide jobs for friends of the administration. Lyn Nofziger, deputy assistant to Nixon, touted his buddy, Spurgeon, as Transpo director to DOT undersecretary James Beggs: "I know Chet to be competent and well-respected in the aerospace industry. I also know that he and his wife are voting and working Republicans," he wrote in a May 1970 note.

The doors now flung open, a dozen more recommendations arrived, half from individuals touting themselves. Meanwhile the mandated limit of eight staff had swelled, with 38 advisors from government, labor, and industry, mostly window dressing listed on Transpo correspondence.

A talented and colorful staff had been appointed by Volpe. William J. Bird, a vice president of Kaiser Industries and California civic leader, became special assistant to develop Transpo, while continuing his day job full time and commuting from California. Harry Krusz, a national authority on community development, became executive director. Consultant Tommy Walker had been entertainment director at Disney.

Agency and corporate resources were there for the plucking. Private companies figured that if they did business with the federal government in any form, they had better do business with Transpo. Time, Inc. hosted a black-tie reception at Washington's Kennedy Center for leading Republicans and the secretary's special guests. Muzak furnished tunes for the secretary's reception center and soon courted other federal agencies and their elevators.

Becoming conscious of appearances, agencies made some image-building gestures. The Small Business Administration scoured the area for minority firms, finally snagging Osborne's Photography as prime supplier to Transpo. Football star Brady Keys' minority firm All-Pro Enterprises was signed

*Various track systems and people mover concepts, including a Ferris-wheel-like auto parking machine (far right), were as prominent as aircraft at the Dulles exposition grounds.*



DEPT. OF TRANSPORTATION



for "soul food, including fried chicken and barbecue." The League of Latin American Citizens was selected to sell tamales, "to help bring high school seniors with Spanish surnames to D.C. for the summer."

Commemorative bronze medals were authorized by the Congress and designed by the U.S. Mint. The U.S. Postal Service issued an embossed eight-cent envelope on Transpo's opening day. Even the local phone company, Chesapeake and Potomac, was recruited and printed special covers for the 1971-72 White Pages. The idealized, racially balanced portraits showed happy Americans using public transportation.

Yet the political skies had already turned dark. Some of the impropriety was rumored by his colleagues to be Spurgeon's doing, and investigators sought evidence that it was Spurgeon himself who had started the backroom efforts to derail Transpo. Despite his White House backing, Spurgeon had been named only executive secretary to Transpo, and later, managing director. As planning was bungled, he was accused of secret efforts to scuttle Transpo 72 and install himself as director of Transpo 74. Allegations surfaced of convoluted schemes and kickbacks. The service contractor was accused of payoffs to the chief of facilities, whose assistant then passed funds to Spurgeon. The chief of the marketing office had to answer charges of trading preferred exhibit space and padded construction contracts for business channeled to his wife's company.

To counter such negative ink, the DOT issued a newsletter, *Transpo 72 News*, to bolster the project's image. Postal franking proclaimed, "Official Business, Federal Aviation Administration." But the flurry of paper had just begun. In a style that would become his trademark, Senator William Proxmire, a Democrat from Wisconsin, blasted Transpo management in a letter mailed to Volpe, simultaneously releasing a copy of the letter to the *Washington Post*. The tactic created front-page headlines before the letter had even been received at the DOT.

"Mr. W.J. Bird makes weekly trips between his home in San Francisco and Washington D.C., first class, at a cost to the American taxpayer of \$388.00

per round trip," Proxmire raged. Bird had spent \$9,000 on travel, and his suite at the Watergate came to \$850 a month. Proxmire listed \$9.00 lunches and \$15.00 dinners at government expense, all duly reported by the *Post*. Proxmire demanded copies of some 30 other contracts, and a courier service routed them in a nearly continuous loop from the Capitol to the *Post* to the DOT and back again.

Transpo construction schedules fell months behind, with no margin for a rainy day. But rain it did. Since 1939 the mean rainfall in October in Wash-



*King of the aerobatic performers, Bob Hoover, shown here with his Shrike, flew a P-51 at Transpo.*

ington had been 2.74 inches. On October 1-2, 1971, in a six-hour period, 2.31 inches fell, and over the course of the next eight days nearly 4.2 more inches. Transpo staff allowed the contractor to truck in more soil, and after tons of new squish, the red Virginia clay was a quagmire. The Federal Highway Administration took over, which sped things up but also ballooned the cost—or at least one can assume so. The cost of the men and machines of the FHWA—and the army of agencies bickering in the mud of Dulles—were never accounted for.

Attention turned to chalets, a term stolen from the French. Chalets are the trade show equivalent of a corporate hospitality suite, complete with

caterers and other staff and amenities appropriate to a formal setting. At today's Paris show, fees for a chalet on the flightline start at \$45,000 and top out at over \$200,000, including five months of construction. Options run from \$6,000 spiral staircases to a \$225 flagpole. For its chalets, called "business centers," Transpo ordered mobile homes, but with fancy roofs.

Enter the low bidder, a Philadelphia firm called General Exhibits, with no construction experience but an attractive design for a modular, hexagonal roof composed of rhombic panels. For \$384,000 they would construct and lease 103 of the business centers. But the contractor could not get a performance bond and had cash flow problems. Its hiring practices upset the local unions, nearly leading to a strike. The company also demanded an additional fat fee if exhibitors were to nail or drill, or apply paint, lacquer, or adhesive. But with leaking roofs, insufficient foundations, and flammable materials, the eyesores failed inspection.

Then came the winds. Transpo officials called it "a freak gust" but it struck with uncanny precision. More than 600 linear feet of roofing was ripped away from the business centers like a giant zipper. Management burped up another \$420,000 to rebuild. Modular Housing Systems arrived, and using 152 modular units in an effort called "miraculous," replaced 37 ruined business centers in 22 days, installing kitchens, toilets, and even wet bars and fenced-in gardens.

But the important greenery—funding—had stalled in Congress, even as estimates and outlays continued to swell. In a remarkable convergence of interests, Transpo became one of the fattest meal tickets Washington lobbyists had ever enjoyed. The DOT scrambled its own staff, then hired private guns to work Capitol Hill. Industries bidding on Transpo construction, or planning to exhibit, sent in their own.

The lobbyists passed morsels around, and in one trail of crumbs, military contractor Sperry Rand alerted the DOT to a quiet midnight House report, hammered out in the holiday rush of December 1971. The House amendment permitted the allocation of advertising costs of up to \$1,250,000 in connection



with Transpo. The DOT and the Department of Defense would jointly develop a formula to fill the stockings. "Surprise," wrote a Sperry Rand official to the DOT's Beggs. "If this is what I think it is, a Merry Christmas indeed!"

There were bigger stockings to fill. What Transpo really needed, Volpe figured, was a high-speed rail link through the Washington suburbs. The city of Paris had just introduced Aerotrain. Transpo would be remiss if it didn't steal that show. Washington needed a tracked air cushion vehicle, or TACV, and it would be a bargain, at \$23.3 million. The proposed demo would include 13.5 miles of track along the north median of the Dulles Airport Access Road. A dazzler indeed, but Congress was already raising unwelcome questions about Transpo's budget.

The Washington Metrorail system was still in its infancy. The TACV was separate and incompatible with Metrorail but would occupy the same right of way. FAA chief Jack Shaffer liked the TACV. "We have endured many years of criticism concerning the accessibility of this magnificent airport, and considering a bold move of this magnitude is most welcome," he wrote. But his worry that the project would not be finished in time and jam the only road to Dulles ultimately killed it.

Transpo eventually got limited funds and four small versions of people movers. The Urban Mass Transit Administration quietly kicked in \$6 million for a cluster of "tracks to nowhere," as it became known nationwide. The TACV, built by Grumman, became part of Transpo's Federal Railroad Administration exhibit.

Transpo traffic signs sprouted for a radius of 30 miles. Spaces were marked for 50,000 cars and 600 buses at fees of \$1 and \$5, respectively. Admission tickets had been sold at metropolitan area banks at \$2.00 per adult and 50 cents per child. Like tax payments, checks were made out to "Treasurer of the United States." Once the show opened, drivers were directed to grassy

areas and the fees collected as visitors exited their cars. Avis employees roamed the parking lots to launch the company's new ad campaign. Throughout Transpo they would provide 10 free rental cars to customers who could identify the foreign language in which the slogan "We Try Harder" was written in bold on lapel buttons. One day the car went to Mrs. Howard Wacktar of Pittsburgh. She recognized the Swahili.

As the opening day neared, aircraft began to arrive, including Fairchild's F-28 and F-100 helicopters, "The Flying Pierces," a Stearman act, aerobatic performer Bob Hoover, Goodyear's Inflatobird ultralight, and several Formula One racers. The U.S. Navy Blue Angels and U.S. Air Force Thunderbirds straddled the weekends in their F-4s. A record was set during Transpo when 64 parachutists jumped from a C-130. The Los Jaguares of the Venezuelan air force flew their F-86 Sabres in a flight of four.

Behind the flightline, exhibitors ranged from Aeronca, American Hansa Jet, and American Telephone & Telegraph to Brazil, Emery Air Freight,

Volkswagen of America, and Wearever Floors. News media reported exhibitors from 10 countries and 400 firms plus their subsidiaries filling over 1,000 stalls. Nations with major contingents included Canada, England, France, Germany, Israel, Italy, Japan, Mexico, and Rumania, with delegations from at least 60 countries. Dick Aarons, then a reporter for *Business and Commercial Aviation* magazine, recalls that the young Fred Smith, founder of Federal Express, was there with a Dassault Falcon business jet. "I went up there with my wife and tried to understand his concept," Aarons recalls. "I couldn't imagine someone making money hauling packages on a business aircraft."

Just a year earlier in Paris, the prototype Grumman F-14 Tomcat had been displayed. That may have been fine for Paris, but this year, at home, the secretary of defense banned public exhibition flights of the F-14 because its capabilities were still classified. Nonetheless, midway through Transpo, an F-14 fired up and executed a maximum-performance takeoff. Thousands cheered, including the Russian delegation, as

*FAA Administrator William McKee (left) didn't support the agenda of his predecessor, Najeeb Halaby, who first had the idea for an aerospace exposition like the Paris show.*

NATIONAL ARCHIVES





the Tomcat made a high-speed pass near the exhibit area.

The fact was that at Transpo, security was bendable. The controversial General Dynamics F-111F swing-wing fighter made daily 10-minute flights. Transpo management wanted a public unveiling of the classified F-15, but McDonnell Douglas demurred.

It was hoped that a hotter Soviet product, the supersonic Tu-144, could appear. Astronaut Frank Borman offered to cash in on his Russian contacts to get the needle-nose Soviet airliner. The FAA's Jack Shaffer, though, dispatched a confidential memo. Congress was killing the U.S. version, Shaffer noted, adding that it would be politically difficult to justify a foreign model. And leasing a Tu-144 but not entering an agreement with our allies for the Concorde would have repercussions. The Red Tide was stayed.

By Transpo's end, three fatal accidents dominated the headlines. The first involved the "Australian Birdman," Robert Harris Kennedy, 26, in his Delta Wing kite. A mixup in signals to his tow driver resulted in the kite turning inverted and plummeting perhaps 400 feet. Kennedy survived the crash but died shortly afterward. Days later, two aircraft collided during the last quarter turn of a pylon race. Despite being damaged, one continued on to land. But the severed right wing of the Cassutt dropped to the grass while the fuselage rocketed on, crashing a half-mile later. The third fatal accident occurred during the final act on the last day of the Transpo exposition, and it involved the Air Force Thunderbirds. One airplane had a malfunction and went out of control, but the pilot ejected. His automatic seat and parachute deployed properly, but he drifted into heat and flames from his own wreckage, and his parachute began burning. He died in the resulting 200-foot freefall.

In addition, several incidents marred Transpo, from false cockpit warnings to overshot landings. Bob Hoover landed partially gear-up into a thickly foamed runway with no injury. Hoover's Mustang sustained minor wingtip damage and was flying again within days. The audience was never endangered by the

accidents or incidents. More attention was paid to the lost child center, which handled an average of 200 children a day. But the public perception and news media coverage, and the outcry from the usual aggrieved parties, cast a pall over the show. Proxmire shifted his umbrage at least temporarily from allegations of insufficient accounting to insufficient safety. But he was soon back on message.

A *Washington Post* article reported that following the show, the people movers would remain at Dulles on an experimental basis for 18 months. Proxmire

Gate crashing had been simple and unchallenged, especially during peak arrival times. Bureaucratic Washington and its friends had also crashed the party in staggering numbers.

mire raised the roof. According to the environmental impact statement, Dulles was to be returned to its pristine state of clay within 30 days of the show's end. Volpe tried to soothe the senator, saying he had hoped to keep the people movers around to save money in case Transpo ran again. But Proxmire demanded the track's removal.

It was the red ink that concerned Proxmire most. Nixon saw him coming, and stressed the need to beat the curve on public opinion. A month after Transpo, the president dispatched a letter to Volpe: "I know you are taking appropriate measures to get across to the American people the story of its outstanding success and the importance of this kind of activity to increased trade abroad." A panel was hand-picked to collect glowing reviews.

W.F. Rockwell, chairman of the Rockwell board, wrote to the blue-ribbon committee: "I am moved to write to you regarding Transpo 72 because of

the benefits which accrued to our company from participation in the show, its importance to the whole transportation industry, and its significance to the American public." General Motors reported 505,000 visitors to their exhibit and 90,201 to their theme center, which demonstrated a future transportation system in Detroit. Sundstrand gushed, "This exposition has the potential to be ten times greater than the Paris Air Show on a regular basis."

But public and corporate opinion was split. George Weiss, who was with Boeing public affairs during Transpo, recalls: "At the time we thought Transpo would be a one-shot deal. I think that Boeing would have gone with it if they held it again in 1974. We had a lot of very important people stop by our chalet, and for a first-time show, it was worthwhile." He summarizes Transpo in a single line: "We were pleased with the attention we got at the time, but unfortunately, there were three deaths."

News media bleated about the three airshow deaths and, separately, the accounting mess. Volpe composed a letter of complaint to the editor of the *Washington Post*. "Your editorial of June 9 concerning Transpo 72 makes me wonder if your editorial writer and I witnessed the same U.S. International Transportation Exposition at Dulles International Airport," he wrote in a draft. Based on advice from his public affairs director, H. David Crowther, Volpe never sent it. ("Such a letter would not be in your long-term best interest," Crowther wrote.)

The General Accounting Office and Congressional critics sharpened their pencils. Attendance reports had ranged from 150,000 to over 250,000 per day, yielding a reported 10-day total of 1.5 million. William Proxmire protested that exhibitor personnel, staff, security, and media should not be counted. Actual attendance, he said, was 503,503. The ticket receipts that could be recovered accounted for only 350,000 heads.

Gate crashing had been simple and unchallenged, especially during peak arrival times. Bureaucratic Washington and its friends had also crashed the party in staggering numbers. In a single FAA memo uncovered by the GAO,



William Vitale had requested 332 free passes for administrative officers, deputies, and their industry guests.

The greater problem was the absence of accounting. Officials relied on pencil ledgers jotted on the fly. "In the car we spoke of the amount that we were going to take in from the sales at Transpo," wrote William Heffelfinger, aide to a DOT undersecretary. "From the look at the current unaudited report, it would appear that the Government's cut on this is about \$800,000," he continued. Revenue from rentals and other sources raised the estimated take for the government to \$2.5 million.

But the pencil numbers were either wishful estimates or pure fiction. In August 1972, the GAO formally required agencies to calculate the "non-reimbursable assistance" to Transpo in addition to the cash amounts. The FAA alone estimated \$1.4 million for in-kind

contributions, ranging from engineering support to graphics to an estimated \$677,361 in personnel time plus 22 percent for benefits.

Agency heads reluctantly supplied the numbers, but also explanations. Jack Shaffer typed a note to his aide: "Some of these numbers appear out of line," he fretted. "As you know we did not fill in behind anyone assigned to Transpo but rather filled up the line with the lowest job in the chain going uncovered. In other words we 'saved' effort in the process of providing services to support the mission." The argument left the GAO baffled.

In May 1973 the *New York Times* reported the cost of Transpo, originally authorized at \$750,000, at an eye-watering \$21.5 million and counting. The Watergate hearings had erupted, and this time the question was not the cost of the rooms but the existence of a

White House tape recorder. The White House, the DOT, the FAA, and Congress let the notion of another Transpo wither. Shaffer became embroiled in a controversy over alleged FAA inaction on Douglas DC-10 cargo doors, which were linked to crashes. In the ensuing furor, Shaffer's reputation was ruined. Later, John Volpe became ambassador to Italy and, like Shaffer, has since died.

One final footnote: The Green Bay, Wisconsin *Press-Gazette* reported that William Proxmire's daughter, Cici, 23 and fresh from Georgetown University, got a job at Transpo. "Miss Proxmire would like to see her dad come out to Transpo 'if for nothing else, to see me,' " she had giggled. Cici had been hired through a modeling agency to distribute pins and maps for a Canadian exhibitor. She remarked that the Senator had seen her uniform and "didn't like the red stockings." —



While Transpo 72 was intended to top the Paris airshow (left), France still hosts the premier event, and a U.S. rival has yet to rise.



*My next stunt was to take out the*

# Love, Tom E

*In 1916, Marine Aviator #4 wrote to his girl about hurricanes, open cockpits, and learning to fly.*



**A**ny potential pilot needs determination and patience. That was perhaps never truer than in the days when aviation was just beginning—a time when aircraft were made of wood, canvas, and wire.

I've been given an intimate view of the experience of one of the earliest fliers through a series of letters the late Colonel Francis T. Evans wrote to a young woman, documenting his adventures in flight school. Evans was Naval aviator number 26, Marine Corps Aviator number 4, and my father.

As a boy, Evans was fascinated by the exploits of his earliest heroes, Octave Chanute and particularly Otto Lilienthal, whose series of successful gliders foretold powered flying machines. Evans got an early start in 1896 at age 10, when he soloed off the porch roof with an umbrella—the tip of his tongue was protruding and nearly got bitten off as knee hit jaw in the collision with Earth.

Evans entered the Navy's first organized pilot training class at Pensacola, Florida, in 1915, then remained there to instruct new trainees. In 1916, he began writing to Elizabeth Kibbey, a Minnesotan whom he met in February when she was visiting family friends. The letters not only reveal his growing affection for a young lady who in time became his wife and my mother, they also provide a unique look at a group of pioneering men whose lives were punctuated by death and discovery in almost equal measure.

—Major Douglas K. Evans, USAF (ret.)

*Francis Evans got orders to report to the Navy Station in Pensacola, Florida, for pilot training in 1915.*



# Little wing & water with the Wright

**April 2, 1916**

Dear Betty,

...Lieutenant Geiger, USMC reported Friday and I took him up for his first jump... Geiger spent last night with me here. I hadn't seen him for nearly seven years and we talked over old times and old friends.

I have been promised a transfer to the Aeroplane Erecting Shop on the return of the [USS] North Carolina. An instructor's job is a big compliment, but I want to get where I can learn more. Am enclosing some pictures. Don't you think that your picture and my picture look rather well side by side?

Love, Tom E

*Evans (below, far left) poses with his fellow students. Future Duchess of Windsor Wallis Warfield visited Pensacola—she is seen here with Navy flight instructor Earl Spencer.*



**April 13, 1916**

Today has been one of many thrills. This morning there were no machines available for instruction, so I had Earl Spencer take me out in the Dunne [Burgess-Dunne AH-7, a tail-less, swept-wing seaplane]. We got off the water after quite a run and made several figures of eight and glided to the water. Spencer then told me to go ahead—well, I ran half way across the bay and couldn't make the blooming thing leave the water, so Spencer tried and did worse. Then we both noticed that the main pontoon was very low in the water so we started home—the pontoon settling perceptibly as we got towards home. I got ready to tie my watch (a perfectly good one) around my neck so if the machine went down I wouldn't ruin the watch. But didn't quite have to swim for it. On examining the pontoon on the runway, we found a hole in the bottom about two feet across.



JULY CLASS 1915  
U.S. NAVY AERONAUTIC STATION  
PENSACOLA, FLA.

ALL PHOTOGRAPHS COURTESY MAJOR DOUGLAS K. EVANS, U.S. AIR FORCE (RET.)



controls. I had never flown with

My next stunt was to take out the little single seater with the Wright controls [which used two levers to warp the wings for roll control]. I had never flown with the Wright control, so I wanted to try it out. Well, I started out and got off the water and soon learned to steer a straight course, then I tried an easy turn and did that all right. By that time I was up about 2,000 feet so I decided to try a glide. Right there is when I started to experience some new thrills. I yawed and bobbed around as I shot downward until I thought I'd turn over and turn around. As I got near the water I shot on my power and started back up again, made a circle of the bay and being up again a couple thousand feet,

I started down again. I did much better so I started home, going up and then gliding down and learning to make my turns a little sharper. Well, I made a nice turn in front of the hangars and glided nicely into the wind and made a perfect landing. Then I ran her up the runway just like I was used to flying the blooming thing for years. Gee, I felt chesty!

At noon, I had the delightful thrill of finding two perfectly good letters from you.

#### May 4, 1916

Had four more hours in the air today although it was a very bumpy day. The wind changed direction every few minutes, so late in the afternoon I thought

I'd go out and see how far up the bumps lasted. I got up to 7,500 feet and was bumped, twisted and thrown around for every foot of the way.

There will be one more letter after this one before I arrive in person. Three rousing cheers! Which means in the language of the ancient leathernecks 'preparedness.'

#### May 28, 1916

Last Wednesday, Mr. Rockwell fell and was killed. Saufley saw the whole thing and says that Rockwell was making a very flat spiral and a gust hit him, stalling the machine which threw it into a side slip and Rockwell did the wrong thing by fighting the controls and the machine got into the vortex of a spiral with nose down and hit the water at about 140 miles per hour. Lieutenant McKitterick was off in the speed boat by the time the machine struck, but none of the men in the boat were good divers, but in a very short time Lieutenant Whiting was on the scene and dove down and got Rockwell out. They used lung pumps on him for two hours but it was no use.

If Rockwell had pulled his controls to neutral, the machine would have gone into a normal glide and he would not have been hurt. The paper has it all mixed as usual and put in a lot of sob stuff. Mrs. Rockwell has three little boys, but the part that wrings my heart the most is that she expects a baby in a few days. Dr. Strite told me. The ladies at the Yard are doing everything they can for her.

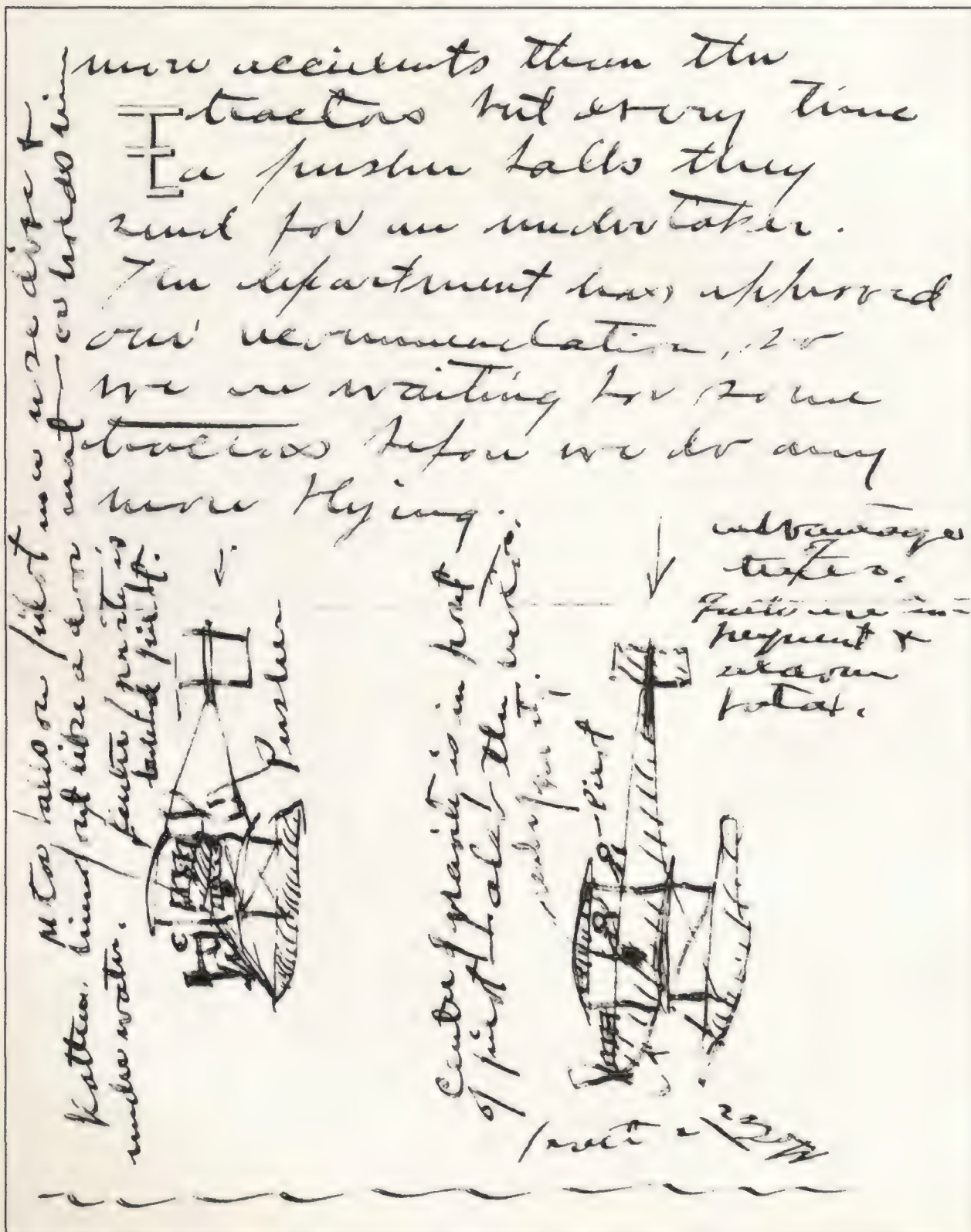
Sometimes I doubt the justice of providence when I see one person being handed so much sorrow and trouble all in a bunch.

Now sweetheart, don't get panicky about aviation. I might step on a banana peel or fall off a horse or get run over by an auto...

#### June 21, 1916

Mac and I bought a canoe so we can paddle out to deep water for a swim in the evenings.

Evans penned da Vinci-like diagrams of pusher and tractor aircraft. Early pilots feared being crushed by a pusher's rear-mounted engine during a crash.





*Wright control, so I wanted to try it.*

Have had more flights in the last two weeks than anyone here, and that isn't much for I have only been up twice in the Dunne, once Friday and once this AM. You see, we all recommended that we discontinue flying these pusher aeroplanes as one's chances in a fall don't amount to much. The pushers don't have many more accidents than the tractors, but every time a pusher falls they send for an undertaker. The department has approved our recommendation, so we are waiting for some tractors before we do any more flying.

Art Smith fell 500 feet in a nose dive in Japan and only broke his leg. An aeroplane, owing to the resistance it offers to the air, can only fall at a certain speed, but with a pusher, after the machine hits the ground the motor keeps on coming. In such a case friends send flowers.

Mr. McCreary is going to give me lessons in free and captive ballooning, after qualifying I will have the wonderful title of Balloonatic.

... My pay as Captain will be \$2,640.00 and my quarters, heat and light, when on shore. At sea it will be \$2,904.00 but no quarters... Can you live on that much?... But there is no use getting excited about what to do as we can find out how much or how little it takes to live on and make our plans accordingly, eh, what! Sweetheart?

Now as I am making my humble effort to be square and reasonable—are we going to be married along about October?

### July 10, 1916

*This letter was written after a hurricane struck Pensacola on July 4, 1916.*

The bridges and wires have been down for nearly a week now and we have received no outside mail since July 4th. The storm started the night of the 4th (Tuesday) and lasted until Saturday night. The rain came in sheets and the wind got up to 106 miles per hour.

Mr. Keyser had just rebuilt the wharf and boat house and it washed up around the porch. I found a piece of my canoe about a foot square. All the wharves at the Navy Yard went, also eight hangars and six aeroplanes, etc.

So with no lights, etc., I have done



*Evans' runabout Thirsty Gertie supplied Earth-bound thrills. Pilots used chimney smoke (background) to gauge wind conditions.*

no studying for a week. Hope some mail gets through tomorrow for I am hoping for a little gray letter.... Thirsty [Evans' runabout] was out in all this storm and went to the Yard and to town for groceries every day, plowing through mud and hub deep water and bucking a 100 mile gale. Needless to say, I was wet all week and the flying sand cut my face but have been wet before and may be again. Never felt better in my life than I do now.

### July 24, 1916

...I thought I told you about Saufley's accident. He was making an endurance flight in one of those old pushers and had been up over eight hours when the flipper [horizontal rudder] which had been improperly attached came loose and he fell and the motor fell on him crushing him. He fell on Santa Rosa Island and I flew over there a few minutes after the accident. I inspected the wreck and saw what had caused his death. It was a piece of bad assembling. Improperly inspected and was no fault of his, poor chap.

Saufley's death was a big blow to Navy aviation. He was, in my opinion,

the biggest man in aviation in the U.S.

Haven't had a flight in a month, but hope to go up soon if this darned weather ever gets good. It has been raining constantly for nearly a month and the roads are nearly impassable. The Keyser's yard is a lake and it sounds like I was in the middle of a frog pond.

### August 18, 1916

Am glad you liked the ring, rather thought you would.

I hope I can get leave along about October because I want to be with my Red Head again before we are married. Spencer expects to get married this fall and if they let him go they'll have to let me go, providing we don't go at the same time.

I suppose you are beginning to realize the sad, sad truth by now, that you are not my only boss—for in the service we never know what to expect next and all we can do is live in hopes and plan again.

### August 30, 1916

All kinds of news—the first and best is that I have passed my exams. I phoned a letter to you about 15 minutes ago. 'Three rousing cheers, "Captain" Evans.' Took my physical and part of my mental exams yesterday and finished this evening at 5:30 PM.

I was booked to make a scouting



*Well I started out and got off the water*

*A flock of seaplanes take off from Pensacola (below). The hangars on the beach were built after a 1916 hurricane. Classmates Richard Saufley, who was killed in 1916, and William Corry sit in the breezy cockpit of a Curtiss AH-8 (bottom), a descendant of the first Navy aircraft, the AH-1. Triumphant: Evans on the day he soloed (opposite).*

flight yesterday 30 miles out to sea and back by compass but my exams interfered. You see, after I have made several scouting flights, get shot from the catapult, etc., I get a certificate that I am a Navy Air Pilot.

#### **February 14, 1917**

*This letter was written after Evans performed the world's first loop in a seaplane the previous day with a Cur-*

*tiss N-9, which was the seaplane version of the famed JN-1, or "Jenny." Evans and McDonnell had been discussing the possibility of looping a seaplane.*

Eddie McDonnell looped the loop this morning. He couldn't sleep last night thinking about how I had beat him to it and he was on the job to start out this morning as soon as he could get a machine. Just after he returned, an order came out from the Commandant that looping the loop was henceforth "Verboten."

It appears that nearly all the naval militia officers sent telegrams home about my loop and I saw an Associated Press account of it this morning. As the Pan American Aeronautic Exposition is on now at the Grand Central Palace it will give them something to talk of, eh what? Well, never again! Sweetheart unless I have to do it. I know it can be done so I'm satisfied.

#### **February 17, 1917**

One of the Naval Militia officers who has just started to fly alone pulled his machine back too far on the getaway and stalled a few feet from the water, sliding over sideways falling on one wing. Didn't hurt him but it wrecked the machine. Mitscher stuffed his nose on a wave breaking the bow of the pontoon and stood tail up on the water. Two in one day is pretty good.

*Mitscher is Marc A. Mitscher, later the captain of the aircraft carrier USS Hornet, from which Jimmy Doolittle led a force of North American B-25s to attack Tokyo in 1942 during World War II.*

#### **April 6, 1917**

Well, we are at war at last. At 4 AM some officers and men went from the station and seized the two German merchantmen at anchor in the bay and they are now flying the American flag!

It doesn't look as if I'd get any leave at all now so if we get married at all it is up to you to plan for it all.

#### **April 19, 1917**

Am the happiest man in the world tonight. My girl says that she will marry me on June 11th and I am finished having my nerves dragged out by the roots teaching people to fly.





*Soon learned to steer a straight course*



I go to the Curtiss airplane factory—Buffalo, N.Y.—from April 24 to May 1st and then I go to the Curtiss Flying School, Newport News, Va. For two or three weeks. And then I'll be detached from Pensacola and ordered to Philly with about 10 days or two weeks delay—to get married—that is, if Headquarters will let me and I hope they will. Anyhow I'll be up there Saturday morning and find out and let you know pronto! Then you will

be able to work your plans.

Well, Sweetheart, I'll not go over for six months yet, but if the war should happen to last, then, every one now in the Army and Marine Corps will get a turn in France.

If the war turns out to be a long one (that is, for the U.S.) then men are going to be very scarce. And if you love me heaps you'll miss me whether you marry me or not (in case of a long war and in case I should not come back).

#### **May 16, 1917**

At Newport News last week I spent an entire day with Carlstrom looking and talking over airplanes and he stated he would take me up in the [Curtiss] triplane the next day and the first good day he would let me take the little single seat biplane (103 miles per hour) out and try it. The next day Carlstrom gave orders to get the triplane out and started out with Eppes to give him his first flight. A few minutes later I heard one of the men close by yelling and I ran out of the building and saw the machine fall and strike. A wing had broken. Both bodies were considerably messed up. I think the cause was very bad air and poor construction and no inspection. Young Eppes was starting in to qualify to get a commission in the Marine Corps Flight Battalion. I signed him up.

...With Russia in the muddle it looks to me as if the war would last a couple of years more and that means that two or three million Americans will have to go over and win the war.... I will be in command of a flight company and maybe the battalion. In either case I will not fly in the little combat machines but will have to content myself with the scout machines on account of my rank and training. As a bachelor nothing would suit me better than to get in a swift little machine and fight duels with those d\_\_\_ Germans.

#### **June 7, 1917**

The answer to my request for leave should be here tomorrow morning. In case it isn't, I am going to call up Washington by long distance.... I am bringing my blue uniform, sword and white gloves—will they match the gown, Dear?

*Evans married Elizabeth Kibbey on June 12, 1917. He served in both World War I and World War II, retired from the Marine Corps in 1944 after 39 years of service, and died in 1974. Elizabeth (Kibbey) Evans died in 1984. Evans' two sons, Francis Jr. and Douglas, both became Air Force pilots—father and sons each won the Distinguished Flying Cross—Francis Sr. in World War I, Francis Jr. in World War II, and Douglas in Korea. —*



# LOUD

For  
Flying  
Out

You've got to paint your fleet to sell some seats.

*by Tom LeCompte*





**T**im McClure, co-founder and executive vice president of GSD&M Advertising in Austin, Texas, says his firm “always likes to bring a big idea to the table,” and in 1988 McClure brought one of his biggest to a meeting with potential client Sea World of Texas. McClure, who counted among his accounts Southwest Airlines, headed by iconoclastic chairman Herb Kelleher, had brought to the presentation a small object hidden under a silk sheet. Just as the meeting was breaking up, someone turned to McClure and asked, “Aren’t you going to show us what’s under the sheet?”

“Oh, I meant to show you this,” McClure answered coyly. He pulled off the cover to reveal a 1/50 scale model of *Shamu*, the now-famous Southwest Airlines Boeing 737 painted to look like a killer whale. “There was a gasp in the

room,” recalls McClure, and when [former] Sea World chairman George Becker Jr. caught his breath, he turned to McClure and asked, “Herb will let us do that?”

McClure looked him right in the eye and said, “Absolutely.”

“If Herb will let us do that, well, you’ve got the business,” Becker said.

In truth, McClure had made the model without consulting Kelleher. So the next day he had the daunting task of flying up to Southwest Airlines’ Dallas headquarters to sell the idea to the airline’s chief. Once again, he covered the model airplane in a little silk sheet, and after going over the details of the sales pitch pulled off the cover. Kelleher looked at it and asked, “George Becker will let us do that?”

“Absolutely,” said McClure.

Before authorizing the use of *Shamu*’s

portrait on the airliner, however, Sea World insisted on bringing in its zoologist to make sure the paint scheme would be an accurate portrayal. As it turned out, McClure says, the 737-300 was the only airliner that could accommodate an anatomically correct profile of a killer whale (right down to the pectoral fins on the engine nacelles). With any other airplane, the proportions are wrong, which was just dumb luck, because the 737-300 is the only airplane Southwest flies.

And thus a marketing alliance was born, and a trend, reborn. *Shamu*, named after the killer whale at Sea World, quickly became the most rec-

*Airlines like American Trans Air have found that the best way to get their message across is to write it on their airplanes.*

CHAD SLATTERY/CHECK SIX







TED CARLSON

HISTORY OF AVIATION ARCHIVES, U. OF TEXAS, DALLAS

ognized airplane in Southwest's fleet. Wherever it landed, people took pictures of it, children pointed at it, and travelers stopped mid-stride to watch it take off or taxi by. Passengers who flew on the airplane came off with pins or bumper stickers that said, "I flew Shamu." Newspapers all over the world featured articles or photographs of the airliner.

McClure says that if Southwest had placed that amount of coverage as advertising, it would have cost the airline \$10 million. "It's been a great ambassador for both companies," he says.

And many other companies have followed the attention-getting *Shamu* into the skies. The sides of airliners are now as likely to show off giant slogans, art, or cartoon characters as they are the name of the airline flying them. Austrian Airlines celebrated the country's 1996 millennium by having two dozen portraits of their favorite sons (and daughters) painted on the side of an Airbus A-320. Mozart got the tail; tennis star Thomas Muster a spot over the wings, and Sigmund Freud a place near the rear exit. An Alitalia Boeing 747 sports an image of a 30-foot wristwatch wrapped around its fuselage, a promotion for Bulgari jewelry. And in Japan, All Nippon Airways has covered its Boeing 747s with characters from Pokémon cartoons.

"You're seeing it more and more and more," says Jon Proctor, editor of *Airliners Monthly*, a magazine that covers the airline industry and devotes a

large chunk of space in each issue to displaying photos of the latest flashy paint scheme unveiled by an airline. In the highly competitive world of commercial aviation, anything that might get a carrier a little extra attention or possibly put a passenger in a seat has become fair game. Although Southwest's *Shamu* is responsible for re-igniting a spark, the idea of painting an airliner to make it stand out from the crowd really started in the 1970s with

## All Nippon Airways covered its Boeing 747s with Pokémon characters.

another flamboyant Texas airline, Braniff International.

Braniff distinguished itself with its "Easter-egg fleet" of airliners with fuselages painted in different bold hues. Decreeing "the end of the plain plane" in Braniff's campaign slogan, advertising executive Mary Wells also gave the airliners designer interiors and flight attendant uniforms that made other airlines seem stodgy. In 1973, Braniff president Harding Lawrence, who was by then married to Wells, took the fashionable flying concept a step further and commissioned artist Alexander Calder, famous for mobiles and

large installations in primary colors, to use one of the airline's DC-8s as a canvas for a flying work of art.

Working on scale models of the DC-8 for six months, Calder, who was paid \$100,000 for the project, presented the airline with a wild design of brightly colored swirls and ellipses. When it entered service in November 1973, *Flying Colors*, as the airplane was known, turned heads everywhere, in part because there was nothing on the airplane to identify it with Braniff. The only name on it was Calder's, in a giant yellow signature next to the door. Three years later Braniff paid Calder another \$100,000 to paint a Boeing 727 to commemorate the U.S. bicentennial. Again, the airplane was a typical Calder creation, a happy flourish of red, white, and blue in undulating stripes. By the end of 1976, Braniff boasted that the Calder 727 had been seen in person by more people than any other work of art in history.

The promotional punch an airline gets for its costumed airliners is hard to quantify, especially since the cost of each project is unique and airlines can negotiate costs either for entire fleets or single airplanes. Southwest Airlines pays \$52,500 for a 737 paint job, which is what the airline paid for *Shamu* as well as for its conventional livery. Of that cost, \$37,500 pays for

*From "The Simpsons" TV show to the Stardust ski resort—whatever advertisers wanted to sell found a place on the flying billboards of Western Pacific, an airline that flew between 1995 and 1997.*







CHAD SLATTERY/CHECK SIX

the labor; the rest is for paint. Boeing estimates that it takes between 120 and 160 gallons of paint to cover a Boeing 747-400, and Aviation Exteriors, Inc., headquartered in Louisiana, charges approximately \$150,000 for a scheme on the 747 fuselage and vertical stabilizer (add \$50,000 if you want to cover those big wings). Australian carrier Qantas paid the company (which also painted *Shamu*) an undisclosed amount to paint a 747-400 sporting a Formula One race car and checkered flag decal to promote the Australian Grand Prix held last March in Melbourne. The job took a team of 30 tradesmen 16 days and 211 gallons of paint.

But a cost-benefit analysis is more complicated than comparing the cost of the paint job to the amount of ticket sales, especially since not all paint is applied to generate profit. For example, a couple of years ago the French carrier AOM, angry with the Paris airport authority's plan to move the airline from one terminal to another, made its opinion public by painting the side of one of its DC-9s with the protest "*Je veux rester à Orly ouest!*" (I want to stay at Orly West). Similarly, Virgin Atlantic's Richard Branson has taken his long-running feud with British Airways to a new level, objecting to the proposed merger between British Airways and American Airlines by having each of his airliners carry the slogan "No Way BA/AA."

In 1995, Western Pacific, a Colorado

Springs-based discount carrier, added a new wrinkle. To bring in extra revenue, Western Pacific rented out the sides of its airplanes as "flying billboards." For \$800,000, including a \$200,000 charge for the paint, you too could have your name or company emblazoned across a 70-ton airliner. The most famous example of the ad-on-an-airliner was the bright yellow 737 tout-ing "The Simpsons," Fox television's

## To bring in extra revenue, Western Pacific rented out the sides of its airplanes.

famous animated family, on the side of the 138-seat aircraft. Marge Simpson and her trademark blue bouffant stretched up the tail. Other "logo jets," as Western Pacific called them, advertised a bank, a ski resort, a hotel, a casino, a wholesale discount store, and a community college. How effective the ads were for the businesses that ran them is difficult to say. For the airline, however, the extra revenue was not enough to keep it flying. In 1997 Western Pacific went out of business.

Since *Shamu* brought back the trend of playing dress-up with airplanes, a number of well-known artists and de-

GEORGE HALL/CHECK SIX (5)



*Far left to right: In 1973, Braniff's Flying Colors by Alexander Calder became the first showoff, but not until Southwest flew Shamu in 1988 did other airlines costume their carriers. Now, anything goes.*

signers have worked with the airlines. New York artist James Rizzi, whose joyful, child-like urban depictions have adorned everything from New York City sidewalks to pop album covers, was commissioned in 1996 by Condor Airlines, a subsidiary of Germany's Lufthansa, to create a paint scheme to commemorate the airline's 40th anniversary. "How many artists get a chance to have a flying sculpture?" says Rizzi, who leapt at the opportunity.

Like Calder before him, Rizzi spent several weeks working on a six-foot scale model of the airliner, a Boeing 757. "I blasted it with detail and lots of color," Rizzi says. "I just wanted to make it happy, fun, and upbeat."

Of course, the demands of art and commerce don't always mix. When the people at Condor saw his first version, "they were kind of overwhelmed," Rizzi says. "They loved it, but they said it was too much."

McClure ran into a little resistance to some of his ideas for the *Shamu* project as well. He wanted to make the interior of the airplane red—all red. Red seats, red carpet, red walls with whale bones drawn on them so that passengers would get the feeling of being in the belly of the whale. And instead of serving what McClure calls Southwest's "filet of peanut," he was going to have Goldfish crackers served and call them "Shamu snacks." But his clients at







COURTESY FRONTIER AIRLINES



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Southwest said there were limits to what accountants—and passengers—will put up with.

Likewise, Rizzi's Condor contact sent him a second model with instructions to tone it down. "They said 'We'll allow you 10 colors,'" Rizzi says.

The result is *Rizzi Bird*, an airplane covered from nose to tail with a cheerful collection of stars, hearts, birds, flying cats, and smiling faces. Once approved by Condor's management, the airline's engineers took over. First they photographed the design and scanned it into a computer, which enlarged it and divided it into a series of stencils

*A different kind of wild design tags the tails of Frontier Airlines, but Austria's flag carrier (left) chose a tamer paint scheme to wish the nation Happy 1,000th Birthday.*

(a process much simplified from the days of Calder, when Braniff engineers had to painstakingly trace Calder's design onto graph paper, then enlarge the graph 25 times in order to transfer the design onto the aircraft). Then, inside a Condor maintenance hangar, the stencils were put into place and the paint sprayed on the airplane.

*Rizzi Bird* draws crowds wherever it goes, so much so that the airline has printed the schedule of where and when the airplane is to land. "The publicity from the project has been tremendous," Rizzi says. For the airline, which prides itself on on-time performance, the only drawback has been that *Rizzi Bird* is constantly struggling to stay on schedule because so many people want to take photos of the airplane while they're at the terminal, he says.

How long the airplane will carry Rizzi's creation is a question Rizzi himself can't answer. On average, airliners need to be repainted or retouched



Find out more at  
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every four or five years. The paint tends to fade from weathering and even more from the intense ultraviolet light at high altitudes. Condor has not decided whether to preserve his creation beyond the expected four-year lifespan of the paint job.

Other well-known artists who have painted aircraft include Peter Max, who last year designed a Continental Boeing 777 covered with bright swaths of blue, red, and yellow. And in perhaps the most spectacular examples of flying artwork, Qantas presented a pair of brilliantly painted Boeing 747-400s that mixed contemporary graphics with traditional aboriginal motifs.

Like *Shamu*, however, all these examples are "one-offs," single airplanes designed to get attention or promote some product or event. In 1997, British Airways took the ultimate step. As part of a \$60 million effort to create a new identity, BA commissioned more than two dozen painters, sculptors, ceramicists, weavers, quilters, calligraphers, and paper artists from around the world to create a series of "world images," according to BA promotional material, that would showcase the airline as a "citizen of the world." The art was then displayed prominently on the tails of the BA aircraft.

"People either love it or hate it," says Christopher Holt, former head of design management at BA, who oversaw the project. In Britain, the conservative press had a field day, accusing the airline of near-treason for abandoning the British flag and crown that had decorated the tails of the airline's aircraft for years. Former Prime Minister Margaret Thatcher called the new designs "terrible" and scolded one BA executive, "We fly the British flag, not these awful things."

Even when the paint schemes are popular, it's not clear how effective they are at dressing up the bottom line. "My question to the ad managers," says John Proctor of *Airliners Monthly*, "is, 'Is it really putting customers in the seats?'"

Ask Diane Willmann, director of ad-



vertising for Frontier Airlines, a regional carrier based in Denver. When the airline was launched in 1994, she says, president and CEO Sam Addoms was looking for a design for the fleet that would stamp Frontier Airlines with the spirit of the West. He hired the design firm Genesis and told its founder Jim Adler, "You know, in the days when I was growing up, people would go out to the airport and it was an event. You'd go out there and stand by the windows and watch the planes come and go.

And little kids would come up and press their noses against the windows. And I want them to do the same thing when they see our planes."

Genesis came up with a series of photographs—339 in all—of different species of Western wildlife to deco-

*Spraying an airliner is the conventional way to apply paint, 160 gallons of it in the case of a 747. For the 757 Rizzi Bird (below), painters sprayed through stencils.*

rate the tails of Frontier's airliners (now numbering 23), each tail with a different image on either side of the aircraft and the airline's name written large across the fuselage. Instead of being painted on, the images are made into large-scale decals and applied to washed aluminum, a process that wasn't available two decades ago. Decals weigh less than paint, are less costly to apply, and offer photographic realism.

"The first six months of the airline, actually maybe the first year, our entire ad budget went to paying for the tails, and I don't regret it," says Willmann. "It put us on the map. We couldn't get noticed otherwise. We were just a little airline based in Denver."

Now, she says, "when we go into a new city, we usually get a picture of our plane in the newspaper only because it's so good-looking, and I don't think that would happen with just a regular-looking plane. We put a lot of stock into that livery, and it's paid off handsomely."

Where is all this heading? At a time when the interiors of airliners are increasingly cramped and austere, the outsides of airplanes are getting positively festive. The once-dull wait at an airport gate could begin to seem like a trip to an art gallery—or a ride down a billboard-cluttered highway. —

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In the 18 months between the launch of Sputnik and the announcement of the Mercury Seven, it was anyone's bet who would be the first man into space.

# First UP?

NASA DRYDEN







by Tony Reichhardt

**T**he briefing chart, once stamped “SECRET” but now turning yellow in a NASA archive, shows a smooth curve with the names of nine test pilots plotted according to their weights. At the lower end, between 150 and 175 pounds, are Bob Walker, Scott Crossfield, Neil Armstrong, and Robert Rushworth. Sloping from there up to 200 pounds, straining the limit of how much human payload an Atlas rocket could lift into space, are Bill Bridgeman, Alvin White, Iven Kincheloe, Bob White, and Jack McKay. The top of the chart reads “CREWMAN AVAILABILITY.” It was presented on June 25, 1958—eight months after Sputnik and four months before the birth of NASA—to Air Force officials making hurried plans to put a “Man In

Space Soonest,” as the secret project was called. On this particular summer day, to this particular briefer, these nine guys seemed most likely to become the first people in orbit.

Other names that might just as well have been included but weren’t: David Simons, Joe Kittinger, Clifton McClure, maybe even Airman 1st Class Donald Farrell. All had done experiments in preparation for spaceflight in the late 1950s, and all had reason to believe, if only for a while, that they might take mankind’s first leap off the home planet. As it was, MISS never flew, and only Neil Armstrong went on to become what we now think of as an astronaut. But in 1958 the question of who—or even what *type* of who—would be the first spaceman was far from settled.

To a casual newspaper reader, an obvious pool of candidates would have been the volunteer test subjects at places like the Air Force School of Aviation Medicine at Randolph Field in Texas, which had been dabbling in space-related research for several years. In February 1958, for example, a 23-year-old airman from the Bronx named Donald Farrell was locked in a chamber with an artificial atmosphere for

seven days, long enough to simulate a moon flight. U.S. Senator Lyndon Johnson of Texas, happy for any good news about America’s loser of a space program, gushed over Farrell’s endurance test, and the *New York Times* pronounced him “in one sense, the first ‘space traveler.’”

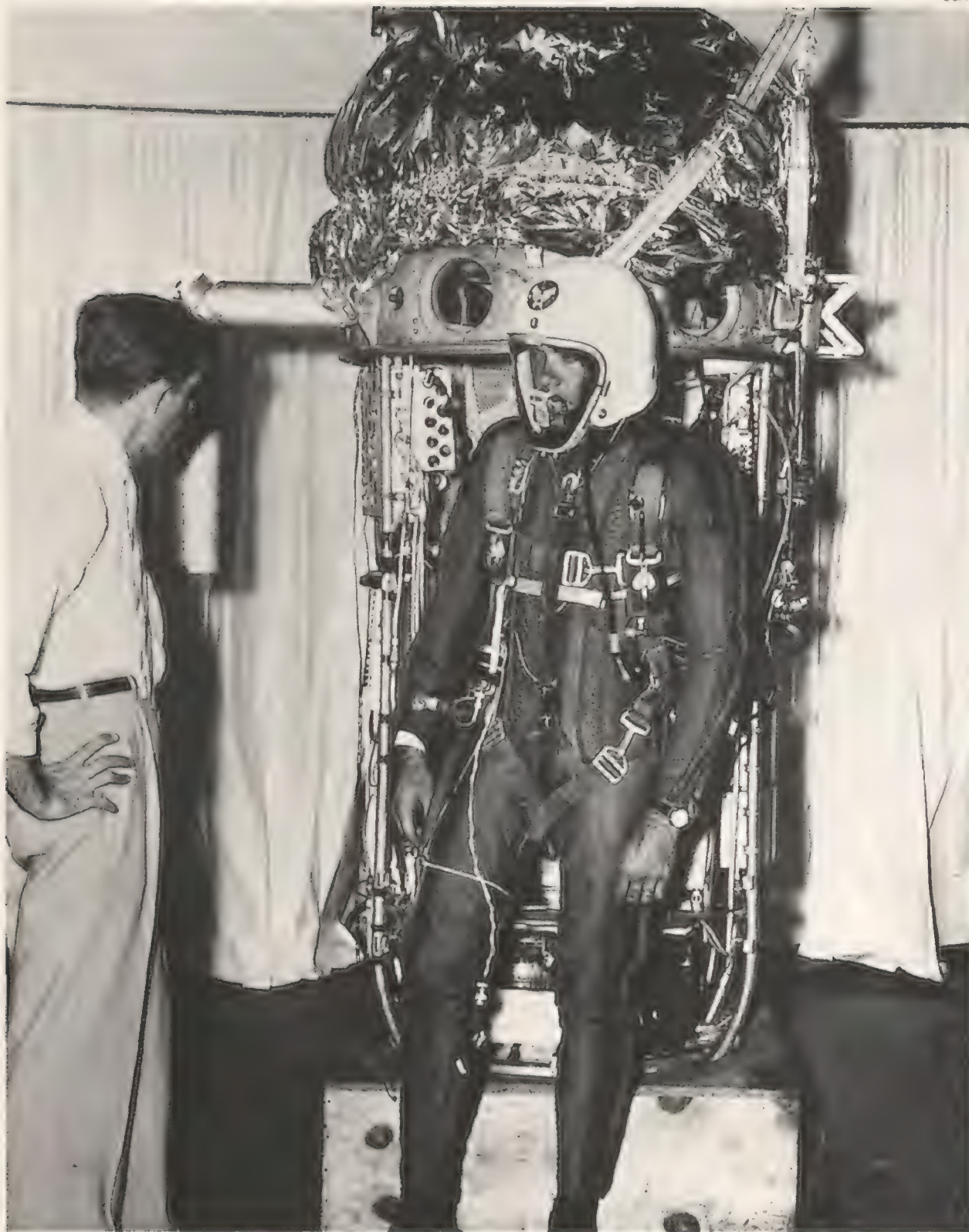
Working at the same time in New Mexico was a group of space researchers with an even more adventurous bent. The unspoken motto at Holloman Air Force Base’s Aeromedical Research Laboratory was “Never do unto others what you wouldn’t first do yourself.” So there was Colonel (and Dr.) John Paul Stapp—a graduate of the School of Aviation Medicine who had been Chuck Yeager’s flight surgeon when he broke the sound barrier—pulling 46 face-squashing Gs on a “rocket sled” in December 1954. Designed to test how much force a pilot ejecting from high altitude could withstand, the sled was based on a German design. During his historic run, Stapp accelerated to 632 mph in five seconds, then slammed to a stop one and a quarter seconds later. Joe Kittinger, a try-anything test pilot and safety officer assigned to Holloman, was flying a T-33 with a cameraman in back to photograph the run from overhead, but he couldn’t keep up. Even today, Kittinger calls Stapp “the bravest man that’s ever been.”

If so, he was in good company at Holloman. In 1955, Stapp asked a young biomedical researcher on his staff named David Simons, who had spent two years launching animals to the edge of space, if he’d be willing to make the trip himself. Simons said yes, and Project Manhigh was born. Kittinger made the first ascent inside the tiny Manhigh capsule—a Jules Verne contraption suspended from a 200-foot helium balloon—in June 1957. He was followed by Simons on a full-up, day-long flight two months later, and by Air Force Lieutenant Clifton McClure, a gung-ho volunteer, the following year.

As a scientist, Simons wanted to see for himself what it was like “up there”—what the stars and the clouds looked like, and how humans would fare on this strange new frontier. Inside his phone-booth-size capsule he reached Manhigh’s top altitude of 101,516 feet, which put him above 99 percent of the

*Before their rocket plane even flew, X-15 pilots (opposite, in 1966) seemed likely candidates to blaze the trail into orbit. From left: Joe Engle, Robert Rushworth, Jack McKay, Pete Knight, Milt Thompson, and Bill Dana. Above: Physiologist Hubertus Strughold with his space mission simulator at the Air Force School of Aviation Medicine.*





*David Simons, a physician and Air Force major (at right), had been launching animals to the edge of space before he agreed to take the trip himself in a Manhigh capsule.*

atmosphere, high enough to see the blackness of space and the curve of Earth below. At the end of his 32-hour ordeal, which he found alternately exhilarating and terrifying, he dropped down in a South Dakota field and was greeted by a farmer, just as Yuri Gagarin would be in the Soviet Union four years later.

Kittinger, the most daring of all, did Simons one better with Project Excelsior in 1960, jumping from the open gondola of a balloon at 102,800 feet, still the world's record altitude for a parachute jump. On the way down, he became the only person to exceed Mach 1 in a freefall. Near the end of the jump, after his main parachute

opened, Kittinger could be heard on the voice tape repeating, "Thank you, God, thank you."

While the official report for Simons' Manhigh flight says it was "intended to investigate the human factors of space flight," most of the Holloman space research was tolerated by skeptical Air Force brass only because of its applicability to high-flying airplanes like the U-2. Even as late as 1957, says Kittinger, "space was a dirty word" in the Pentagon.

The launch of Sputnik on October 4 changed everything. Suddenly each of the military services knew exactly how to send someone into space, and quickly. The Navy's Manned Earth Recon-

naissance (MER) program would orbit an inflatable, winged reentry vehicle by 1960. Wernher von Braun, at the Army Ballistic Missile Agency in Huntsville, Alabama, proposed a joint services project called "Man Very High." He had watched the Air Force balloon flights with great interest, and he invited Simons and Kittinger to Huntsville to discuss modifying their Manhigh capsule for a Redstone rocket. Simons came away excited, but by April the proposal had been shot down. Von Braun repackaged it as the Army-only Project Adam, a ballistic, suborbital shot up to 150 miles, with a man crammed inside a cylindrical pressure vessel much like Manhigh's. He even tried selling it as a way to move soldiers quickly around the globe using missiles. But Project Adam, too, ground to a halt.

The only scheme that gained any real momentum in 1958 was the Air Force's Man in Space Soonest, which would use first a Thor, then an Atlas booster, to put a blunt capsule in orbit. The MISS concept would later morph into NASA's Mercury project, and several of Mercury's guiding spirits were involved as advisors, including Max Faget and Robert Gilruth of Langley Field in Virginia, a research center operated by the civilian National Advisory Committee for Aeronautics. By March 1958, MISS was the subject of frequent high-level meetings, and David Simons and John Stapp were among those doing the briefing.

At one such meeting at NACA's Ames center in California, Simons outlined a program of Manhigh-style balloon flights that could help train the pilots for MISS. (An Ames official wrote in the meeting minutes, "Should I call him a pilot or a biological specimen?") Stapp recommended that the first man in space be either an engineer with medical training or a medical man with engineering training.

Because they'd been thinking about it for years, the doctors were the experts when it came to assessing the risks of spaceflight. By 1958, they had



pretty well dismissed most of the worries, but a few unknowns remained. In his 1953 book *Man in Space*, Heinz Haber of the School of Aviation Medicine at Randolph, who with his brother Fritz had designed Donald Farrell's space simulation chamber, wrote that weightlessness "will be the most dismal and the strangest" effect awaiting the first travelers beyond Earth.

But the medical researchers did not have this line of inquiry to themselves. As early as 1950, Chuck Yeager and Scott Crossfield, the North American Aviation test pilot who would fly the first X-15, had both tried a method of simulating zero-G invented by the Haber brothers—taking an aircraft on a steep climb, then coming "over the hill" to achieve half a minute of weightlessness. In the 1950s, just about every hot pilot tried the technique at least once, according to Crossfield. Joe Kittinger flew many such runs at Holloman with David Simons on board as a researcher, and both enjoyed the feeling. So did

*Hey, Yeager, watch this! Joe Kittinger broke the sound barrier during his freefall from 20 miles (right). Centrifuge runs helped establish how many G-forces an astronaut could take (below).*

Crossfield, who liked to do his weightless runs upside down.

Crossfield had done other "extreme" tests, including pulling 9 Gs in a centrifuge, and was happy to report no pilot-related show-stoppers for his X-15 rocket plane, which was being designed to climb much higher into space than Manhigh had, if only for a few minutes. Despite his sanguine assessment of the risks, some scientists—not serious re-



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searchers like Stapp, whom he respected, but outsiders—continued to predict dire consequences for the first astronauts. "I think some of those guys were just looking for big government contracts," he scoffs today.

It wasn't just intellectual dishonesty that bothered Crossfield. He feared that the worry-warts would kill the X-15 before it got off the ground. In the post-Sputnik scramble, he and others at North American had proposed an advanced orbiting version of the rocket plane as a way to achieve "man in space soonest." That idea had been rejected in favor of the MISS ballistic capsule. Now Crossfield saw the whole thing being turned over to the medicine men and the missileers, who he perceived as having a "great disdain for wings and pilots."

In April 1958 he was asked to serve on a group chaired by Randy Lovelace, a leading figure in aerospace medicine, to set guidelines for human factors and crew training for the fledgling space program. Crossfield did his best to steer the conception of an astronaut away from "passive biomedical subjects" and toward the kind of test pilots who were lining up for the military's X-15 program. The panel's final report, issued in October, called for potential crew members to be checked out in ground simulators, centrifuges, balloon capsules, "and finally in supersonic aircraft such as a two-place X-15."

More than half the names on that June 1958 MISS briefing chart would in fact fly the X-15: Armstrong, Rushworth, McKay, Walker, and Bob White. The rest were stars at Edwards Air Force Base. Bill Bridgeman, a test pilot for Douglas Aircraft, had taken his company's Skyrocket nearly to Mach 2 in 1951, and was even quoted by Heinz Haber in *Man in Space*: "I pick a spot in the sky, and I imagine I'm going right on through a hole, out of the earth's orbit. Am I driving this airplane or is it taking me somewhere? I am awed and apprehensive."

Air Force Captain Iven Kincheloe had already been dubbed "Mr. Space" by the press for piloting the Bell X-2 rocket plane to a world's record of 126,200 feet in 1956. Two weeks before his name appeared on the MISS weight chart, he had tested a science



# Collier's

JUNE 25, 1954 • FIFTEEN CENTS

Why Does Ike Say:

**'BETTER  
CHECK THAT  
WITH HERB'**

**CHARITY RACKETS-**

**They Can Be  
Stopped**



**FASTEST  
MAN on EARTH**

(SEE PAGE 25)

fiction-y spacesuit called the Mark I in a simulated flight to 100 miles. If anyone was primed to be the first space pilot, Kincheloe was. But a month later, he crashed to his death in an F-104 over the Mojave Desert.

As for Crossfield himself, "Yes, I was interested [in making the MISS flight]," he says. "However, I wasn't pushing it." He had his hands full with the X-15, and was still holding out hope that an orbital version would fly someday. Besides, Lovelace and others joked that they would blackball him if he volunteered. "I was too independent," he says. "I had a bad habit of turning off the radio if I didn't like the help I was getting from the ground."

In the end, it turned out to be neither the Holloman crowd nor the rocket plane pilots who became the first men in orbit. All this time, another, stronger undercurrent had been flowing, which led to the creation of a new civilian space agency and put the Air Force out of the man-in-space business. Immediately after opening shop in October 1958, NASA set about picking candidates for Project Astronaut, soon renamed Mercury, which was essentially the MISS concept in new clothes.

Throughout the fall a small team of doctors and psychologists in NASA's Space Task Group struggled to come up with a list of requirements for the

first astronauts. By early December they had drafted an invitation to pilots, arctic explorers, deep-sea divers, mountain climbers, and anyone else who did hazardous work in severe environments and who had demonstrated ability to "react adequately under conditions of stress or emergency."

Their call for "research astronaut-candidates" was to have gone out to the public on December 22. But hardly was the plan formed when NASA officials realized the net was cast too widely. The Mercury project was moving too fast to spend valuable time screening proposals from every adventurer in America. So NASA's new administrator, Keith Glennan, and his deputies decided to limit the pool to military test pilots. When they presented the idea to President Eisenhower shortly before Christmas, he okayed it immediately.

For Ike, it was a natural decision. He had zero interest in the romance of space travel, and was only intrigued by the prospect of military men spying on the Soviets from orbit. "Eisenhower was not picking the first humans to go to the moon," says American University space historian Howard McCurdy. The people he had in mind "were more in the legacy of Francis Gary Powers than Lewis and Clark."

So that was it. Only military test pilots, who already had security clearances, need apply. Strictly interpreted, that meant no Scott Crossfield or Neil Armstrong, both civilians. And no David Simons, who was a physician.

The three Manhigh pilots at Holloman had different reactions to the NASA decision. Kittinger, the only one who was a military test pilot, talked to Stapp about applying, and his boss thought he would have a good chance. But in the end, he decided to stick with what he was already doing, including preparing for the high-altitude Excelsior jumps. Clifton McClure, the 26-year-old Manhigh pilot who'd been dreaming about spaceflight since he was a kid, wanted badly to go into orbit, and was "devastated" to not have the chance, according to Simons.

Simons downplays his own disappointment at not being invited to participate in Mercury. He threw his hat in the ring to become director of biomed-





*John Stapp made headlines by pulling high Gs during a series of tests in 1954 (opposite). He probed the limits of human endurance in the new age of jets and rockets. Scott Crossfield (above) flew the first X-15 two months after the first NASA astronauts were announced. In August 1957, David Simons took in this view from his Manhigh II capsule, floating at 100,000 feet.*

ical research for the astronauts, but was rejected. So he went on to a rewarding career in mainstream medical research, ending up at Emory University in Atlanta, where he lives today. Don't look back, he says.

And yet, every so often, he surely does think back on that day in August 1957, six weeks before Sputnik, when he had outer space all to himself. Simons was the first man in history to watch the sun rise and set from above the atmosphere. When he took a break from work and just sat there munching sandwiches and chocolate bars in



his tiny capsule 20 miles up, he turned reflective. Later, in his official pilot's report, he wrote: "It seemed right that I should be going toward space, as if that was where I belonged. In this sense I experienced a separation of emotional ties and interests from the earth be-

low and felt an identification with the void of space above."

Unlike many of the astronauts who would follow him, Simons was always more interested in the place he was going than in the machinery that took him there. ➤



# Through the Lens of Ben Ross



**He photographed presidents and the most beautiful women  
in the world, but it all started with airplanes.**

*by Chad Slattery Photographs by Ben Ross*





**A**s an aviation photographer, I have made several hundred thousand photographs during my career. But only one photograph hangs on my studio wall, and it was not made by me.

The picture shows a sleek dark car, improbably hung in the hazy sky under a set of aluminum wings and pulled along by a huge propeller. One of my friends suggests it's a satire, what Dali might have done with a computer program like Photoshop. Another thinks it looks like a silver dragonfly carrying off a resigned beetle. I think it's an icon.

*Left: Convair's car-plane. Below: Ben Ross, left, and his pilot during an air-to-air shot.*







In 1948, when Ben Ross took the picture, America's postwar aviation industry was buoyant with optimism. Magazine writers predicted that fleets of personal airplanes would soon be criss-crossing the sky. Ercoupes, Navions, Aeroncas, Silvaires, Culvers, Cubs, Seabees, Swifts, Rockets, Champions, and Voyagers soared across brochures aimed at the tens of thousands of returned pilots and navigators newly nested in suburbs across America. Al Mooney advertised a single-seater that would get 50 miles to the gallon and be "cheaper than a car!" And in San Diego, Convair developed the ultimate in personal aircraft: the silver-winged auto that flies across my wall. In one photograph, in one-fiftieth of a second, Ross captured something essential about postwar America. I look at that picture today and feel the era's confidence, its faith in technology, its extravagant and often reckless consumerism.

Ross didn't have an assignment to photograph the strange hybrid, but he figured he'd have no trouble selling photos of it to magazines. He was confident enough to hire a photo plane at his own expense.

*P-51 pilot Vernon Richards, hand covered with briefing notes. Right: One of Ross' classic close-ups—an Aeronca floatplane.*







There was a problem, though. “Convair didn’t want me to make the photo, because the project had been canceled,” Ross recalls today. “It turned out they’d been more interested in making the car than the wings.”

Ross had a talent that, in my experience, is critical to a successful career in photography: the ability to track down the right person. To get the picture of the car-plane, he arranged a meeting with Theodore Hall, the aircraft’s designer, and persuaded Hall to fly the craft for a photo session over San Diego. It was the car-plane’s last flight. Ross got the only photographs that would ever be made of it in the air.

Ben Ross—originally Rosenblatt (“You couldn’t really get along with a Jewish name if you wanted to advance in photography,” he says)—was born in Manhattan in 1916. After high school he went to work as a messenger for photographer Rudy Arnold at Brooklyn’s Floyd Bennett Airfield. “When an event happened, Rudy went up in the air and



*Above: A sun-struck Seabee amphibian.  
Left: A Rocket 185, an homage to an engine.*



took still photos and newsreel [footage], and I'd take them around to the newspapers and newsreel companies," Ross says. "I gradually started working in the darkroom mixing chemicals, then learned to process film and make prints. I began taking pilot license photographs up on the roof and I got more confident with cameras. Rudy started letting me help out taking pictures with him."

Arnold didn't like to travel. When a hurricane ripped through New England in 1938, he figured that the Coast Guard would launch aircraft to assess damage and asked Ross if he'd try to fly up there on one. Ross grabbed a camera, scrambled onto a Grumman Goose as it fired up its engines, and was on his way.

Hooked, he started spending less time in the darkroom and more on the runways, lugging a bulky Speed Graphic that on his small frame looked more like an anvil than a camera. When a priest crashed a Piper Cub on his first solo flight, Ross' photo of another priest administering last rites in front of the smoldering wreck made the front page of the *Daily News*. "I got a New York City press card which I wore on my fedora just like *Front Page*," he says.

Floyd Bennett Airfield was, in Ross' words, "isolated way out on the ass end of Brooklyn," but it was by no means quiet, and he kept busy: "There was a marijuana field 500 yards south of the field and police raided it. People would speed along the empty roads and have serious accidents—those big wrecks were a [newspaper] staple. Howard Hughes was there for his 'round-the-world trip and snuck out a bathroom window to avoid all us photographers. Wrong Way Corrigan took off from there. As the war came, all the lend-lease planes flew into it."

Photographers starting their careers today might take for granted the current technology's conveniences. The camera I use, for instance, can rip through film at eight frames a second; computer chips focus its zoom lens and calculate exposures perfectly. Ross' Speed Graphic, on the other hand, was little more than a light-tight box. Imagine holding a shoebox to your eye with one hand while rolling a small thumbwheel to focus the lens with the other. Do this in a tiny Piper Cub a mile high in cold choppy air through an open door, loosely attached to the airplane with a rope through your belt. And there was another condition that made a steady hand and steady nerves essential: When Ross shot in color, he used Kodachrome, a film that back then was so

slow that he was forced to shoot at a fiftieth of a second—under the circumstances a long exposure.

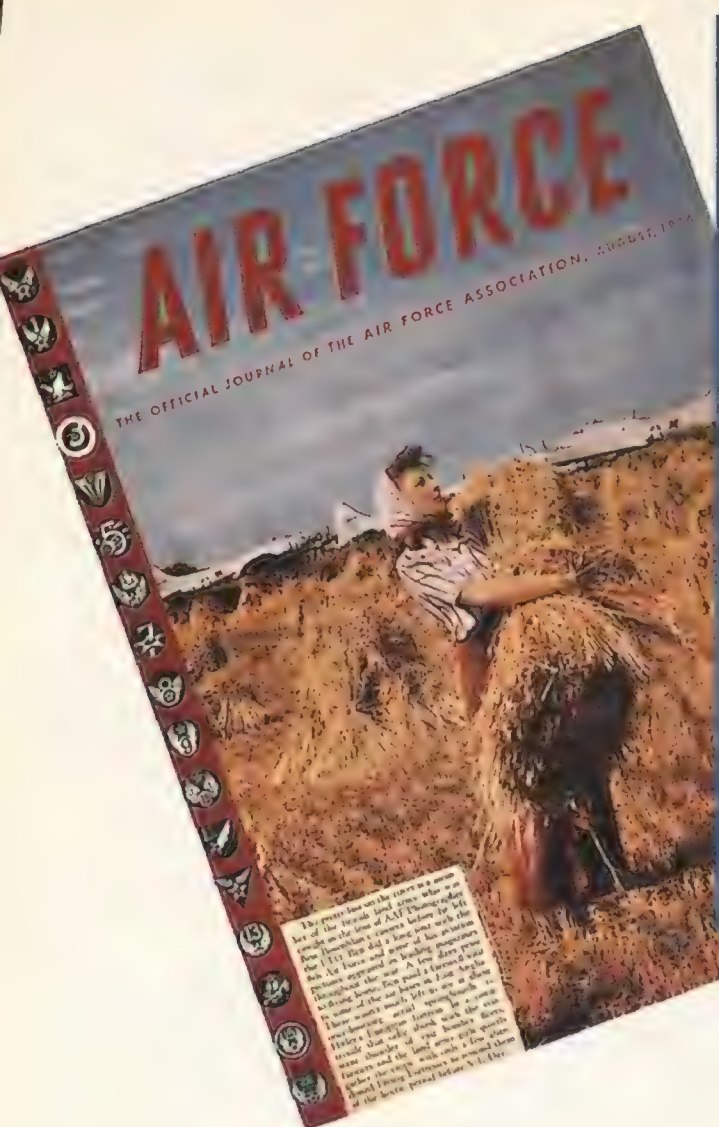
When the United States entered World War II, Ross went through basic training, then joined the Eighth Air Force's Combat Camera Unit as a still and motion picture photographer. He flew in B-17s, B-24s, B-25s, and B-26s, making elegant shots of the fighter formations that accompanied the bombers as they flew over England, Scotland, and Ireland. The military distributed his photographs Stateside, where they appeared widely in various magazines and newspapers.

Ross also photographed the pilots. Most were barely 20, but the classic portrait that Ross made of P-51 pilot Vernon Richards shows how quickly war aged them.

*Below: A Republic P-84, Ross' only jet. Bottom: the quirky XL-15 observation aircraft.*







Richards' face is wrinkled beyond his years by combat and high sunlight, and hardened by familiarity with death. When *Look* magazine published his picture in 1945, hundreds of women wrote to ask his name and propose marriage.

What no one could tell was that the photograph was, to an extent, set up. Ross knew that returning pilots would bum a smoke just as fast as they could jump down from the cockpit. As he watched Richards light up, he spied the cryptic briefing notes written on his left hand, and asked the pilot to switch his cigarette over to that hand so the photo would show both the notes and the cigarette. That quick thinking exemplified Ross' genius for distilling multiple elements into a single powerful image.

After the war Ross teamed up with his reporter brother Sid to produce feature stories on aviation subjects. They covered one-plane airlines, flying farmers, National Guard weekend flyboys, and backyard helicopters. "His experience both before and during the war made him extremely adaptable," remembers Sid. "He could be fast and instinctive or slow and methodical, depending on the situation."

Ross also began creating dramatic advertising shots for aircraft manufacturers. His formula was simple: Fly in close, then get closer. Ross made one picture, of a woman piloting an Aeronca, when the photo

plane and the target plane were no more than 15 feet from each other.

To get those tight shots, Ross devised a photo flight pattern that is still used today. Taking off in morning or late afternoon light, he would order the target plane's pilot to tuck in close behind him at the five o'clock position. ("We didn't use radio back then," Ross notes. "It was all hand signals. *Higher. Lower. Closer.*") The formation would then begin a lazy 360-degree circle until the low sun streamed through the cockpit's windshield, illuminating the pilot and any passengers. Fifty years later, the covers of such magazines as *Flying* and *Plane & Pilot* still echo the Ross signature style: Fly close. Crop tight. Spotlight the pilot.

They were trademarks, but they were not commandments. For Republic Aviation, Ross flew high above a Seabee amphibian just as it began lifting out of the water, its bright wings lifting the pilot above the dark and roiling sea. "I liked to photograph over water," Ross recalls. "The air wasn't as bouncy, you got all these great textures below, and the plane stood out."

Republic later brought him back to photograph its first jet, the P-84. He got so close that the inch-high serial numbers were clearly visible. It would be the only jet he ever photographed.

The same year, he slipped just below the wing of Boeing's XL-15, a prototype of its Scout two-place observation aircraft, and

*Magazine work, a profitable venue for Ross' aircraft portraiture.*



made a photograph that perfectly captures the airplane's quirky features: the tricycle landing gear that seemed to be installed backward, the twin inverted rudders, the extended flaperons, and the fuselage that looked like a glassed-in bathtub.

Sometimes Ross had to find drama in aircraft on the ground. The Rocket 185 that Johnson Aircraft asked him to photograph in 1947 was a sleek, low-wing monoplane with retractable landing gear and a 190-horsepower Lycoming engine that gave the two-seater a top speed of nearly 200 mph; on the day of the shoot, however, the aircraft would not start. Ross quickly improvised. "Since Johnson advertised it as the world's fastest lightplane, I decided to emphasize the engine," Ross recounts. He plopped low on the ground near the nose, aimed up, and then had the presence of mind to make one more adjustment. He rotated the camera to make the format vertical. "I figured if I left room at the top for their name, *Flying* magazine would buy it as a cover," he says. He was right.

The photo highlights another Ross trademark. The confident model atop the





Rocket, obviously meant to be the pilot, is a woman, and the young man on the ground is looking up to her with admiration. In those years it was rare to see a woman portrayed as a pilot. But because the manufacturers all wanted to sell family planes, Ross included women in his shots whenever he could. His photo of a Cessna 170 suggested a flying station wagon, with a family preparing to load luggage, hatbox, and children for a weekend jaunt. "The couple in this photo actually owned this plane, and these were their kids," Ross says. "The baby in the wife's arms showed that it was a very safe plane for all of them."

By 1948 Ross had logged 2,000 hours of flight time. His photographs had been on the covers of every airplane magazine, and he was the most widely published aviation photographer in the world. But he saw a downturn coming. Those returning airmen were struggling to make car payments and buy a home and feed families; they couldn't afford to buy airplanes. "There were a lot of [aircraft] companies and a lot of competition," Ross remembers. "You'd get calls from Stinson to do their advertising one year and the next year they were out of business. You could see the handwriting on the wall."

That year *Parade* magazine offered the Ross brothers an opportunity to do celebrity stories in Hollywood. They quickly accepted. It was an easy transition. "I approached famous subjects the same way I did airplanes: simple and straightforward, without fancy lighting," Ross says. Over the next three decades he photographed dozens of personalities, including Marilyn Monroe ("She was always late"), Zsa Zsa Gabor, Audrey Hepburn, Robert Kennedy, and Dwight Eisenhower. "In 1963, for Gettysburg's 100th anniversary, I walked with General Eisenhower across the battlefield," he recounts. "I made my photos as he began discussing why General Lee lost. He was very knowledgeable about the battle." Two years later he caught Brigitte Bardot as she swept into a press conference in New York City. Through Ross' artful printing, the star sparkles against an expanse of dark-suited reporters.

In 1978 Ross left *Parade* to pursue more lucrative industrial clients, including Brooklyn Union Gas. An executive at the company suggested Ross gather up a selection of prints he'd made over the years and exhibit them at the company's headquarters. An art director there



eventually bought nine of them. Ross had made the transition from an assignment photographer to a collectible artist.

Today, his prints go for an average of \$1,000. "Anything I've ever seen of Ben's has been a strong photograph," says Tom Gitterman, director of the Howard Greenberg Gallery in New York City, which handles sales of his work. "His aircraft images are such dynamic compositions. By cropping close, he injected interest into photos that would normally just be documentaries."

This fall Ross will turn 84. He maintains an active social life, talking on the phone, lunching at restaurants near his tidy Brooklyn Heights townhouse, enjoying the company of his wife Mimi, and visiting Sid. He also stays active professionally, going into Manhattan to look at exhibits and participating in various photography associations. This summer, he learned he will be getting the American Society of Media Photographers' Lifetime Achievement Award, one of the profession's most prestigious honors.

Ross no longer takes on photography assignments, instead concentrating on his exhibition prints, which he produces in the basement with his old Omega D2 enlarger. "I can't work in the darkroom 18 hours at a clip like I used to," he says, "but I keep getting calls for the flying car and closeups of Marilyn Monroe." He shakes his head. "Fifty years ago, I never thought these pictures would be treated as art." ➔

*Opposite, top: President Eisenhower at Gettysburg; below: Brigitte Bardot, a study in star power. Above: A Cessna 170, practically a member of the family.*



# The Airplane Nobody Wanted

**Why the F-20 Tigershark was born an endangered species.**

*by Ralph Wetterhahn*

**I**t was daybreak on a February morning in 1984, and I remember walking across the apron at Edwards Air Force Base in California. Sunlight was just spreading across bone-white Dryden Lake bed to the east. In the pallid light, the Northrop F-20 Tigershark was almost invisible. My heart started thumping as I moved around the afterburner nozzle and walked toward the fighter's nose. This was a prototype aircraft that could fly at Mach 2. Was I really going to get to fly it?

At the time, I was a U.S. Air Force colonel flying a desk at the Pentagon. My ticket to Edwards—and a test drive in the F-20—was my role in the export of U.S. military hardware. It all came about because I headed a small division at the Pentagon in the Air Staff's International Programs office, the purpose of which was to accompany and aid U.S. aerospace companies on sales expeditions to foreign markets. Since no salesman worth his salt would dare stand up in front of a bunch of foreign decision makers, especially pilots, and praise an airplane he hadn't flown, I had been sent to Edwards to log some hours in the Tigershark, which Northrop

hoped to sell to the air forces of foreign countries.

I got two flights in the F-20 that February day. I had had no formal ground school. Instead I had simply read the flight manual and listened to a few briefings. I would be able to evaluate, therefore, not only the aircraft's performance but how much (or little) training an air force would have to invest in if it bought the aircraft.

My first flight included a maximum-performance climb followed by some engine drills and a supersonic sprint. To say the F-20 climbed would be an understatement. It launched. At 40,000 feet two minutes later, the ground controller had me do a low-speed throttle burst, which requires taking the aircraft's engine from idle to maximum afterburner. I pulled the power back to idle and my airspeed sank. Then I slammed the lever forward. The acceleration was quick and smooth. I repeated the sequence, and the second go was just as slick as the first. Then I let the F-20 run out to Mach 1.5 before pulling the thrust lever out of afterburner. To see how maneuverable the fighter was, I flew some acrobat-

ics before making a smooth landing back at Edwards.

The second flight called for wringing the airplane out at high Gs. After I landed, I came away with only one thought about the F-20: Great airplane!

**T**he Northrop F-20 Tigershark was a derivative of two earlier-generation Northrop aircraft that had brought the company great commercial success: the T-38 Talon and the F-5 Freedom Fighter. The T-38, the standard trainer for military jet pilots, has been in use since the 1960s, and the Air Force plans to fly it for several more decades. The F-5, which first saw service in the Vietnam War, became the standard fighter in NATO and developing countries in the 1960s and '70s; it was purchased by such nations as the Netherlands, Norway, Canada, Iran, Taiwan, and Saudi Arabia. (Saudi pilots even flew the F-5 in the Gulf War.)

*Northrop had high hopes for its F-20 Tigershark, which boasted admirable performance capabilities, including a one-to-one thrust-to-weight ratio.*







The T-38 and F-5, both lightweight, agile, twin-engine aircraft, are known for the ease with which a pilot, particularly a new one, can fly them. But by the mid-1970s, the F-5 was no longer competitive with other fighters that had appeared or would soon appear on the world market: the General Dynamics F-16, the French Mirage fighters, and the newest Soviet MiGs. So in 1975 Northrop decided to upgrade the F-5 with new avionics and a new engine. Says former Northrop chairman

of the board and chief executive officer Thomas V. Jones: "We at Northrop always were looking and thinking about what can we do better with an airplane that we [already] have. So we always had a certain percentage of our airplane designers working out ahead. Not waiting for the government to specify anything because I believe strongly that's not the way the best ideas come."

The new design, initially designated the F-5G before being renamed the F-20 several years later, would be a single-engine aircraft, as opposed to the twin-engine F-5s. For the engine, Northrop selected the reliable General Electric F404, which is used today in both the Lockheed Martin F-117 and the Boeing F/A-18. "The idea was: With the F404, the F-5 could become a real hot rod," says Air Force historian Richard P. Hallion.

And it would be a hot rod that Jones believed he would have a guaranteed market for. After all, Northrop had sold more than 2,600 copies of the F-5 se-

ries to 32 countries. It seemed reasonable to Jones that they would want to buy a familiar but significantly more advanced version to upgrade their military fleets. Jones figured that his company could count on selling at least 1,500 F-20s to foreign buyers.

In fact, Jones was so sure of the F-20's future sales, he decided that Northrop could afford to fund the development of the fighter on its own, independent of assistance from the U.S. government. "I didn't want to get into the political hassle of getting funding from the government," explains Jones. "I didn't want to have the problem of too many people telling you what to do."

Though Northrop had an F-20 systems program office at Wright Field in Ohio, there was no substantive Air Force oversight of F-20 development, leaving the company free to make its own decisions. Consequently, Northrop was able to develop the F-20 quickly and efficiently at a specially built production center in Hawthorne, California. Thirty-two months after the program began, Northrop rolled out the first airplane.

Yet despite developing a much-praised high-performance fighter at a total cost of \$1.2 billion, Northrop didn't sell a single F-20. "That's the way it went, unfortunately," says former F-20 program manager Bob Gates. "As I often said to myself and to others, 'We did everything we were supposed to do on the F-20 except end up selling it.'"

Those of us who flew the airplane or who were in some way involved with the program still think about the Tigershark and wonder how things went so wrong for an airplane that seemed so right.

Historian Richard Hallion was working at Edwards Air Force Base in California when Northrop started test flying the F-20 there in 1982, and he remembers it as "a superb lightweight fighter. There is no question of that. It had very little difficulty defeating most conventional airplanes. If it was up against an F-15 or an F-16, that might be a different matter." But Hallion says that even pilots of the front-line F-15s and F-16s would be wary of going up against the F-20 because "it was a very,



ALL OTHER PHOTOGRAPHS COURTESY NORTHROP GRUMMAN CORPORATION

*Northrop chairman of the board and chief executive officer Tom Jones (left) believed that the Tigershark, shown below being rolled out in Hawthorne, California, on August 1, 1982, would rack up big sales as an export fighter.*





very capable combat airplane.”

The F-20 was a multi-role fighter that could carry bombs and launch a variety of missiles depending on mission requirements. The General Electric F404-GE-100 engine produced 18,000 pounds of thrust, giving the F-20 a thrust-to-weight ratio of one-to-one and enabling it to climb at 53,800 feet per minute. The F-20 had a multi-mode radar with a range of 50 miles, and it had the fastest scramble time of any fighter in the world: From a cold start, it could take off with all systems combat-ready in one minute. Plus, the Tiger-shark, with its sleek, simple design, was a real beauty. No wonder it was the most photographed airplane in Northrop history.

Colonel James H. Doolittle III of the U.S. Air Force (ret.), the grandson of the World War II hero of the same name, was the first Air Force pilot to fly the F-20. “I remember vividly the great pleasure I had flying the jet,” he says. “The airplane exhibited tremendous acceleration, enviable engine and afterburner throttle response, and carefree engine handling even in the very-high-altitude, low-speed upper left-hand corner of the flight envelope. The airplane was docile in the traffic pattern with truly delightful control harmony, and the cockpit integration was really very well thought out. I had an easy time of it flying many challenging test points because the F-20 was such a delightful pilot’s airplane.”

A pilot’s airplane is exactly what Jones had envisioned for the F-20. He also wanted a fighter that was as easy to manage on the ground as it was in the air. He realized that reliability and maintainability yielded improvements in fighting ability (the longer an airplane is in the shop for repairs, the fewer air combat hours it can log). Jones believed that building a robust aircraft was of particular importance in selling the F-20 to developing nations, where the levels of maintenance experience and resources were likely to be lower than those of more developed countries. So from the start, the F-20 would sacrifice a little performance in order to make big gains in reliability. “We worked so hard on maintainability, reliability, operability, how to win air battles,” says Jones. “How you may



not be as fast as an airplane like the F-15, but it’s capable of beating it, by using its agility.”

Northrop’s marketing plan was to offer the F-20 as a high-performance fighter at a cut-rate price of \$11 million—significantly lower than the going rate for the popular F-16, which sold for about \$18 million. “[The F-20] had a lot of agility,” says Welko Gasic, who was Northrop’s chief F-20 engineer before moving up to general manager. “It had about 95 percent of the performance of an F-16, but it cost about 70 percent of the cost. So that was the basis on which we tried to encourage customers to purchase it: almost the same performance but it cost a lot less.”

A few years after Northrop started thinking about upgrading the F-5 into the high-performance F-20, Jim-

*On May 27, 1983, the F-20 made its international flying debut at the Paris Air Show.*

my Carter moved into the White House. In 1977 he became concerned that the sale of military technology to foreign countries, particularly developing nations, was having a destabilizing effect on global security. Israel already had the F-15 and F-16, and NATO countries were buying F-16s by the hundreds in all manner of production-sharing programs. Other countries were getting top-of-the-line equipment in sweetheart deals arranged by U.S. aerospace companies and foreign militaries, often without much oversight by the U.S. government.

Carter decided to impose restrictions on the export of advanced military technology. He believed the United States had a special responsibility



as the world's premier arms seller to take the lead in restraining arms sales. In 1980 Carter directed the Pentagon to work with industry to develop intermediate-level aircraft under what was called the foreign export, or "FX," program for those countries that didn't rate top-end technology like that found in the F-15 and F-14. The FX fighters were to have a performance capability between that of a Northrop F-5E and an F-16.

General Dynamics' contribution to the FX program was the F-16/J-79 Falcon, a modified F-16 powered by a General Electric J-79, which produced 18,000 pounds of thrust, instead of the standard 25,000-pound-thrust Pratt & Whitney F-100 engine. Northrop's offering to the FX program was the F-20.

Two years before the FX program began, Northrop got its first suitor for the Tigershark. The government of Taiwan wanted to buy 160 Mach 2 fighters to protect itself from its neighbor, the People's Republic of China. But Carter vetoed the sale in 1978.

By 1981, Carter had been replaced by Ronald Reagan. In the Carter years, the F-20 had enjoyed a somewhat protected market under the FX program, but in July, Reagan changed the rules. A two-tier concept for arms sales—intermediate-level fighters to some countries and advanced fighters to others—was no longer thinkable: Reagan and his advisors decided that if U.S. friends and allies wanted and needed the most advanced military technology, the Pentagon should make it readily available to them. Says Hallion: "Reagan wanted to meet the Soviet threat head-on wherever it surfaced."

Just as the F-20 was about to get air under its wings, Jones got the air knocked out of his program. The new situation, with no protected market for the Tigershark, forced him to switch sales tactics; no longer would the F-20 be marketed as an intermediate-level fighter. From now on, the F-20 would have added capabilities, such as an inertial

*In more than four years of testing above the desert of Edwards Air Force Base in California, the three lovingly maintained F-20 prototypes made more than 1,500 flights.*









navigation system and the AIM-7 radar-guided missile, to make it competitive with the F-16 and the F-15. But Northrop test pilot Paul Metz worried that the F-20 would be forever tainted by its initial marketing as an intermediate-level aircraft, and that potential buyers wouldn't see it for what it was: a damn good fighter. "It more than matched the F-16 of its time," says Metz. "But no matter how good it is, it doesn't appear like you're buying the top of the line. You have an opportunity to buy the Rolls-Royce or you can buy the Chevrolet. In fact, I think the F-20 was a Rolls-Royce also."

But potential customers didn't see it that way. Military organizations tend to want the most advanced technology, regardless of whether it best suits their needs. Getting the most advanced fighter also became a badge of honor with potential F-20 customers, who reasoned, "Aren't we as good friends of yours as country X or country Y, which is now operating F-16s?" And so the fighter most coveted by foreign countries became the F-16. "The F-20 didn't have mass appeal to the clients and customers that actually in point of fact could have made very good use of it," says Hallion. "They wanted what they saw as the more sophisticated, more advanced, and more progressive airplane."

Pakistan, Venezuela, and South Korea signed up to buy F-16s in 1981. Then Taiwan made another request for modern fighters. Up jumped Northrop, but the Tigershark was turned down by the Reagan administration, which did not want to do anything to jeopardize its warming relationship with the People's Republic of China.

Jones forged ahead undeterred. The retirement of F-5s, F-4s, and MiG-21s meant there would be a world market for some 4,000 fighters, and Jones hoped to tie up 1,500 of those sales with F-20s. Because he knew well the delays that can crop up in the military testing done at Edwards Air Force Base, he bought a fuel truck so that he wouldn't have

to wait each time he needed to gas up one of his airplanes. He also secured his own chase aircraft, a Northrop F-5, so that his crew wouldn't have to wait in line for an Air Force chase plane. He built his own mission control and data collection room so that he wouldn't have to compete with other programs for test times. With Jones greasing the skids, the Northrop F-20 took to the air for the first time on August 30, 1982, above Edwards. Northrop test pilot Russ Scott flew it to 40,000 feet on that first hop and ran it out to Mach 1.04.

Fast, yes, but a little late. At the time, the world was now in awe of the Israeli air force, which in June had taken its F-15s and F-16s into the skies over Lebanon and trashed the Syrian air force with a 55-1 kill ratio. Suddenly most nations friendly to the United States concluded that with a small number of F-15s or F-16s, they could wreak havoc on batches of Soviet-bloc aircraft. Little thought was given to the extremely high level of selectivity and pilot training employed by the Israelis. Little thought was given to the fact that all but two of the Israeli kills were made with low-tech, heat-seeking missiles and cannon fire, the basic armament of the Tigershark.

By 1983, the redirected marketing

program was on track. In May, the Tigershark performed at the Paris Air Show. The international press and 800,000 spectators gave thumbs-up reviews after test pilot Darrell Cornell's 11 demonstration flights. In August the second F-20 made its first flight.

Part of Northrop's sales plan for the F-20 was to have pilots of every stripe fly the airplane. The fighter was so user-friendly, foreign pilots were able to fly it after only two days of simulator training. "It was a single-seat airplane, and we put pilots from foreign countries who spoke little or very poor English into this airplane loaded with [practice bombs], and they [went] up and they invariably did it very accurately, very well, never scratched an airplane," says Metz. During the life of the F-20 program, more than 80 pilots from 19 countries flew the fighter. But still, no one stepped forward to buy it.

Even though many other pilots loved flying the F-20, just like I did, it had something of a credibility problem. "When you're talking about foreign governments, they always look to the U.S. government to kind of help them in supplying the airplane for spare parts, et cetera, and since this airplane was not in the U.S. inventory like the F-16, they had some qualms about buying

*In the middle of an August night in 1982, the first prototype was transported past Los Angeles' city hall on its way to Edwards to begin flight testing.*





*Featuring an aluminum composite airframe, the F-20 had an enviable combat weight of only 16,015 pounds.*

[it],” says Welko Gasich. “The government should have helped us, but they weren’t, because they were trying to protect the F-16.”

Gasich is referring to what he sees as the Air Force’s motivation to encourage foreign sales of the F-16 at the expense of the F-20. The more F-16s that General Dynamics could sell globally, the lower the cost of each airplane to the U.S. Air Force. And since the Air Force wanted to buy more F-16s, they had an incentive to market it widely abroad.

The U.S. Air Force is not a monolith, however, and Tom Jones points out that his fighter had its admirers. “I got super support from the [U.S. Air Force] systems command at Wright Field,” says Jones. “They went to great effort to endorse our technical evaluations. The problem was not the development people, it was the procurement people.”

Jones also points out that the rival F-16 had some powerful supporters in Congress. General Dynamics had a plant in Grand Prairie, Texas, and at the time, Congressman Jim Wright and the chairman of the Armed Services Committee, John Tower, both from Texas, were lobbying hard for a company that employed their constituents. Former F-20 program manager Bob Gates believes, however, that the worldwide market was large enough to accommodate both fighters. “The F-16 was a very large program in itself,” he says. “There was certainly room for both airplanes—there’s no question in my mind.”

In April 1984, the third F-20 airframe rolled off the production line. Although there was a lot of polite interest, no sales developed. The Tigershark still seemed to be an unknown quantity. Northrop decided on a bold marketing ploy: Show off the aircraft to the world. At the end of August, the first two F-20s launched an around-the-globe tour.

First stop was the Farnborough Air Show in England. Fifty-three-year-old Northrop chief test pilot Darrell Cor-



nell flew all the demonstration flights. Though the demos required the pilot to sustain up to 9 Gs, Cornell declined to wear a G-suit. Former F-20 crew chief Jim Johnson recalled recently: “I asked him why [he didn’t wear a G-suit] and he said when it inflated he lost the feel of the aircraft.”

During the next eight weeks, Cornell would fly Tigershark Number 1 on every ferry mission and every demo flight on its tour of 20 countries. The other three test pilots took turns ferrying the Number 2 aircraft but flew no official demos. The tour was running like clockwork, demonstrating both the performance and the relia-

bility of the F-20 (most of the spare parts brought along remained unused). But by the time the team arrived at the final stop on the tour, South Korea, Cornell seemed to be feeling the effects of two months on the banquet-demo circuit, which included frequent time zone changes.

On October 10 Cornell was awakened before dawn. “He came out to the aircraft about an hour before takeoff time,” recalls Johnson. “When he walked over to the boarding ladder, he just stood there hanging onto [it] a couple of minutes. Finally he said, ‘Come on, Jim, we gotta go sell aircraft.’ ”

“I strapped him in,” says Johnson.



"He took off from Osan and did a max-performance climb before he headed for Suwon," where he was to do the show. It was the last time Johnson would see his pilot alive. Cornell crashed doing the last maneuver of the last demo at the last stop on the tour. Paul Metz witnessed the accident: "Darrell pulled up and did a roll and lowered his landing gear when he was upside down [at] probably a couple of hundred feet. From there the aircraft went into an inverted stall. It looked like he was trying to maneuver out by pushing forward to get the nose up."

A few months after the accident, Northrop's F-20 marketing effort began to produce some interest. My boss at the time, General Larry D. Welch, head of the Pentagon's international military sales, traveled worldwide tout-ing the F-20. "Our briefing, though we strove for balance, favored the F-20 because that's what we wanted these countries to buy," says Welch, who, unlike many in the Air Force, believed that the Tigershark best suited the needs of developing countries. "In Thailand, for example, they were very re-

*Countries that flew the F-5 (right) were prime customers for the F-20. In 1984, Northrop hawked the Tigershark during an eight-week around-the-world tour, visiting 20 countries, including Egypt (below).*

ceptive to the F-20. Then we finished by telling them they could also choose the F-16. *That* got their attention."

Air Force Brigadier General Wilbert D. Pearson, who was a major back in the 1980s, was an Air Force test pilot assigned to the F-20 program. His flight experience sold him on the F-20 concept, so he keenly tracked the marketing effort. "Jordan, Korea, Turkey, Morocco, Singapore, Thailand, and Bahrain all requested Pentagon Letters of Offer and Acceptance," he says. An LOA request indicated serious intent to purchase, since numbers of aircraft and prices are requested. "Bahrain actually followed through, ordering four aircraft for its tiny air force," says Pearson. The problem with the other countries was that once they were told they could also buy the F-16, they requested prices on it as well. Singapore was the first to decide, signing up for



eight of the F-16/J-79 models. Thailand would follow a year later with an order for 16 F-16s.

Meanwhile, Northrop readied the second F-20 for the upcoming Paris Air Show. Paris in the springtime would offer an opportunity to allay any fears regarding safety, reliability, and performance that may have arisen from Cornell's accident in Korea. On May 13, 1985, the Northrop team headed for Europe, stopping in Goose Bay, Labrador, Canada. The pilots decided conditions were satisfactory for practice flights, and by mid-afternoon the following day, Paul Metz had flown two practice demos and David Barnes was on his fourth flight of the day. While running through the final sequence, the airplane entered a shallow dive and hit the ground, killing Barnes. Canadian Aviation Safety Board investigators concluded that the crash was caused by the pilot experiencing a G-induced loss of consciousness and that mechanical failure was not the cause of the crash.

Although Northrop tried to minimize the effect of the accidents, clearly the impact was grim. Studies verified by the U.S. Air Force concluded that in neither case was the crash caused by a system malfunction, but the accidents clouded the F-20's reputation as an easy-to-fly airplane. What made the accidents all the more tragic is that by the time they occurred, the F-20 program was already on the road to nowhere. Yet the test pilots, believing mightily in their airplane, were driven to show it off to potential buyers. "Dave and Darrell were extremely close good friends, so it's a real personal loss for me," says Metz, who now flies as a test pilot for Lockheed Martin. "But for the program, we were in an uphill battle to survive. I still have very strong feelings about this airplane. In my experiences with different kinds of airplanes, I obviously get emotionally attached. I may be biased, but this is one airplane that should have gone into production in terms of the amount of testing that went on with it, the quality of the airplane itself—the avionics in particular were absolutely outstanding. It should have gone into production."

But it didn't. And after six years of trying in vain to find buyers for the Tigershark, Jones made the decision





*Although it spent \$1.2 billion of its own money developing and marketing the F-20, Northrop didn't sell a single fighter.*

to put the airplane to rest. In December 1986, the F-20 program was officially terminated. The company had been writing off the Tigershark costs quarterly, and it continued to survive because its government contracts, such as that for the B-2 stealth bomber, more than covered the cost of developing the F-20. In 1990, the sole surviving F-20 prototype went on display at the California Science Center in Los Angeles, with Jones, Metz, and others in attendance at a small ceremony.

Though Northrop's failure to sell the F-20 did not sink the company, the program's fate affected the way aerospace

companies undertake research and development. No company is likely to fund its own major development effort anytime soon. But I admire Jones' courage in thinking his company could go it alone. "This kind of thing is really commendable," says Hallion. "It's a gutsy decision, it's a risky decision. And unfortunately in this particular case, it didn't pay off for Northrop. But I think they were entitled to take the shot. I liked the F-20. It was a neat machine. And you look at it, and you thought, Boy, you know, if there were the bucks out there for some of these countries, a buy of F-20s might not be a bad thing for them. But you also recognized, Gee, the times are just not right. Had that been an airplane five years before, I think that might have made all the difference in the world."

Jones, who now owns and runs a vineyard in Los Angeles, looks back on the F-20 program without regret. "When you enter the fray, you enter knowing you can lose," he says. "You're not going to win all the time. As long as I was CEO, I said, 'Listen, we're going to go upstream just like a salmon. If we're strong enough, we'll get up to the top.' And almost everything we did was on the basis of our own initiative. And when you've got opposition—I used to say it's a little bit like if everyone's shooting at you, you must be near the target. We got nicked a few times, but we also did damn well if you look back. But we did lose on some, and I think the F-20 would be one I'm sad about because I'm sure it would have been a terrific airplane."

He'll get no argument from me. —



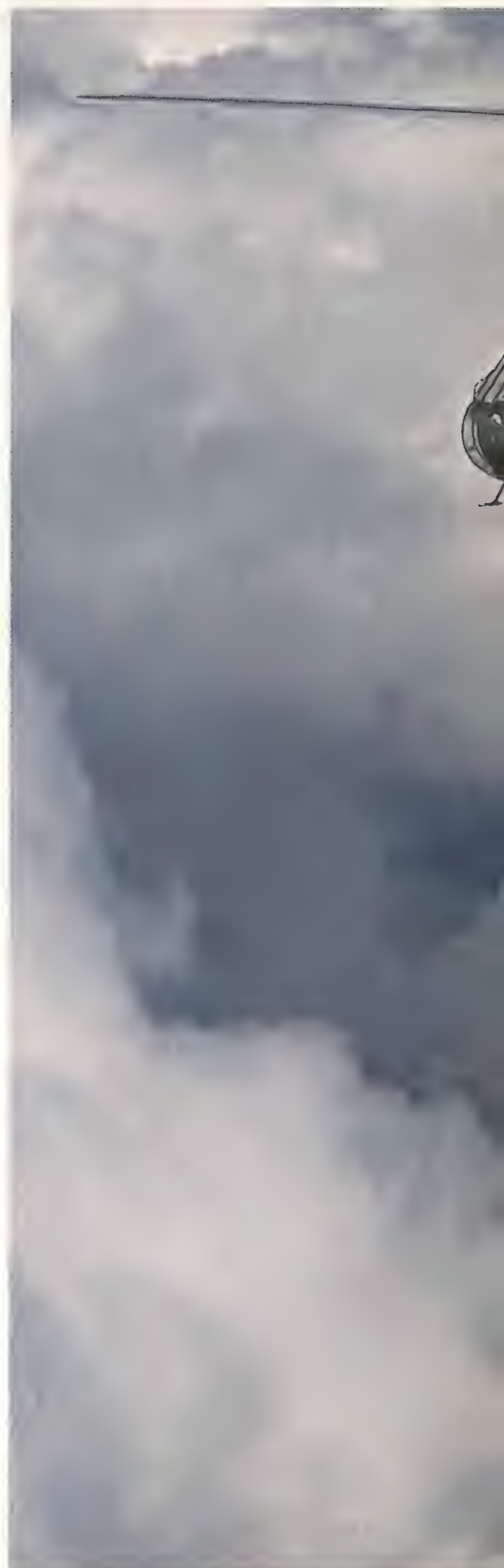
## ► SIGHTINGS ◀

When you're hurtling to the ground at 125 mph, it's difficult to concentrate on such things as lighting and camera angles. Somehow, though, Max Dereta manages to keep his wits about him under these circumstances, so he can create spectacular images of skydivers in action, giving would-be spectators on the ground a great view of what *should* be a spectator sport. "I always wanted to show to the 'outside world' how artistic, beautiful, and exciting skydiving can be," explains Dereta, a Dutch freelance photojournalist and adventure travel photographer who has been a skydiver for 34 years. "I am always looking for unusual situations and exotic locations."

During a recent international skydiving event called Moscow Boogie, a pair of Russian Mi-8 helicopters flying at 14,000 feet helped Dereta capture an

exhilarating group leap (right). The jumpers first moved out onto the fuel tanks and landing gear to pose for Dereta, who was flying aboard the second Mi-8; then, at his signal, they all leapt off to begin their long descent toward Volosova, near Moscow.

Back in the U.S.A., the Pacific Northwest's majestic Mt. Rainier served as a backdrop for a freefall formation above Kapowsin, Washington (below). Dereta took the picture of the "star" formation with a helmet-mounted camera while freefalling slightly below the circle of jumpers. He had to act fast to get the parachutists and Mt. Rainier in the same shot: They stayed in formation for only 60 seconds before releasing their parachutes. The streamers on the skydivers' legs were merely "a decoration for a good shot," Dereta admits—as though the photo needed any sprucing up.









# Tanned, Rested, and Ready

## Space Cowboys

Warner Brothers. Scheduled release: August 4, 2000.

**O**ctober 1958. The Race is on. Four of the U.S. Air Force's best of the best, Team Daedalus, have a dream—to be the first Americans in space. As *Space Cowboys* fades in, Hawk Hawkins and Frank Corvin are testing the limits of their X-2. At the edge of space, Corvin orders Hawkins to level off. The men's rivalry is as intense as their record setting. That very day, the book on Project Daedalus is closed. The National Advisory Committee on Aeronautics (NACA) is giving way to the National Aeronautics and Space Administration (NASA), and the first American in space will be—a chimp named Sam. Daedalus' dream disintegrates. Decades pass.

Forty-two years later, NASA personnel are working to avert a deadly catastrophe. A Russian communications satellite, Ikon, has suffered a systems failure and is fast on course to crash into Earth. Problem is, Ikon's technology is extremely antiquated, though oddly all-American ("borrowed" by the KGB back when). The only man who can fix it is the man who designed it—Frank Corvin, now in his late 60s.

*Space Cowboys* is a fictional but realistic adventure produced and directed by Clint Eastwood, who stars as Corvin, the tough-as-nails leader of Team Daedalus. It's the story of one generation's dream of space, the first generation for which the dream was plausible, and the group of test pilots who put their lives on the line to push the envelope and "just go."

Corvin, though still embittered by the events of long ago, strikes a deal with NASA and resurrects the dream, then recruits the rest of Team Daedalus. With Tommy Lee Jones as Hawk, the rebel; Donald Sutherland as Jerry O'Neil, the suave bachelor; and James Garner as Tank Sullivan, the fatherly buddy, it's a

cast to die for, as they say in Hollywood, playing made-to-order roles.

Eastwood, an experienced helicopter pilot and owner of an Aerospatiale A-Star, was naturally drawn to the subject matter, and clearly his experience helped. But it was the story and the characters, he says, that moved him into production: "I would have done this movie without having any knowledge of planes or space, just because I liked the story, the idea of these guys who had become obsolete going back into the program and into space."

*Space Cowboys* features a payload of state-of-the-art special effects, rendered by Industrial Light and Magic (ILM)—an eyeful of aviation hardware, plus more technology, the company claims, than any other film to date, in locations that range from Earth to skies to space. "This isn't about going out and meeting three-eyed green monsters," says Eastwood. "So it has to be what it is, what everybody knows, and everybody knows what space and astronauts in space look like now. If you want an audience to lose themselves in a movie, you don't want something glaring to come popping up



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that throws them out. You want them to believe it."

To that end, *Space Cowboys* was filmed with the cooperation of NASA, and the storyline—which covers the transition from NACA to NASA—hovers "close to the historical facts," says former director of advanced projects Lou Peach, now chief engineer for the Universities Space Research Association at NASA headquarters, who served as one of the many agency consultants on the film.

The crew spent months in pre-production to achieve an authentic look and feel. Essentially, if it isn't the real thing, it's a precision reproduction. Okay, there was some artistic license taken—no X-2 ever had two seats, for instance, but otherwise, the replica of the Mach-busting rocket plane's exterior was rendered to specs.

"There was an awful lot of drafting," says production designer Henry Bumstead, who, at 85, is a legend himself, having earned Oscars for his work on *To Kill a Mockingbird* and *The Sting*. "We spent maybe four months on this alone to put in all the detail," he says, nodding toward the central portion of the Ikon satellite on the set. The crew even added tangles of extra cables and wires "to make it look more Russian," Bumstead adds, grinning.

Countless hours were also spent reproducing the distinct lighting of space—"from the hot, very bright sun on the white spacesuits to the Earth light and image of the Earth in the reflection on the curved faceplates of the helmets," says cinematographer Jack Green.

The biggest challenge was achieving believable weightlessness. "We had to use every trick in the book to do it," says Eastwood. Against a backdrop of space reconstructed from NASA's high-resolution digital photographs, some scenes feature computer-generated bodies—based on the actors' heights, weights, and physiques—programmed to move as they would in microgravity.

As Corvin, Hawkins, Sullivan, and O'Neil struggle to defy their age, the young astronauts who train alongside them—Ethan Glance, played by Loren Dean, and Roger Hines, portrayed by Courtney B. Vance—give the geezers plenty of Ensure and grief. The members of Daedalus, however, know something about the power of the media, and cover their bases.

By the time the solid rocket boosters break away, these veterans not only command the respect of flight commander Eugene Davis—played by William Devane—and their young astronaut crew members, they demand it. They earned these slots. When Daedalus reaches Ikon, even Walter

Cronkite emerges from retirement for their first live global broadcast. As the repair gets under way, however, Corvin discovers one small detail the powers-that-be left out, and the film shifts into a kind of suspense-filled warp drive.

Despite its special effects and high production values, *Space Cowboys* really does take wing on its story, paying homage to pioneers like Chuck Yeager, Alan Shepard, and John Glenn, among others. "They were the ones who broke the sound barrier, who took planes up until they came apart almost, who learned things that everybody else is still utilizing," says Eastwood. After a moment of reflection, he adds, "I would like the audience to see that and understand that the efforts these guys made back then, the amazing chances they took, got us to where we are today." —A.J.S. Rayl is a Malibu, California-based writer who covers science, technology, and pop culture.

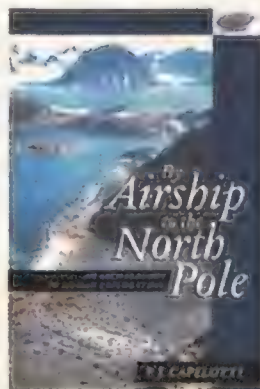
## By Airship to the North Pole: An Archaeology of Human Exploration

by P.J. Capelotti. Rutgers University Press, 1999. 209 pp., \$26.00 (hardcover).

This slender volume touches on many topics as it recounts a string of heartbreaking failures during man's quest, 100 years ago, to reach the North Pole by air: polar exploration, aviation history, the human drive to explore, the function of advertising in reporting on expeditions, and the role of air travel in promoting world peace.

Hiding in the middle of that jumbled compendium is a fantastic thriller that begs for silver screen treatment. Imagine the airship *America* shuddering out of its hangar into an Arctic summer gale. Scenes of incredible daring (and stupidity) leap from the pages despite Capelotti's matter-of-fact treatment.

Two men took the lead, between 1896 and 1909, in trying to reach the North Pole by air (not until 1926 did Roald Amundsen succeed). They were Swedish engineer Salomon August Andree and American newspaperman Walter Wellman; the first was considered a lunatic, the second a fraud. Both men built substantial base camps at the icy anchorage of Virgo Harbor, on Danes Island, 700 miles below the North Pole, and it was there that the author ventured in 1993 to



## HEAVY METAL

### USAF F-15 Eagles: Units, Colors & Markings

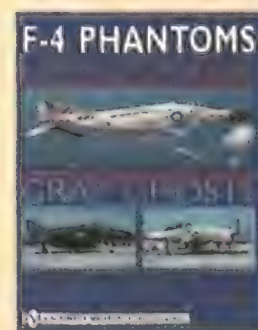
by Don Logan. Schiffer Press, 2000. 352 pp., b&w and color photos, \$59.95.



A photo-heavy treatment of the Eagle, from flight test to the F-15E. Also includes the Maneuvering Technology Demonstrator and other F-15 test programs, as well as paint scheme references for modelers.

### F-4 Phantoms: U.S. Navy and Marine Corps Gray Ghosts

by Peter E. Davies. Schiffer Press, 2000. 240 pp., b&w and color photos, \$49.95.



A detailed Phantom history recounted through memoirs, photos, and diagrams.

study the remains of their expeditions. Capelotti's mission was to use archeological techniques on a relatively modern site like Virgo Harbor to interpret how events transpired at the turn of the century—to create a historic record that incorporates hard-to-define qualities like leadership and vision. He has chosen to study a stark landmark in the terrain of human history—suspended in time and space between the Olduvai Gorge and Mars.

In 1896 Andree built a hangar on Danes Island and inflated his semi-dirigible balloon *Eagle* with hydrogen, but he couldn't launch it because winds from the south failed to blow. The next year he returned, and on July 11, 1907, *Eagle* flew. Andree's small party sent several dispatches by carrier pigeon over the next three days, but the men never returned; in 1930 the remains of the party were found, as was undamaged film that produced the haunting photos that enhance this book.

Wellman, a sensationalist reporter for the *Chicago Record-Herald*, made five polar attempts in various versions of his airship *America*, each ending in a spectacular disaster. Wellman lost several men under his direction and nearly ruined his own health, but he lived to try the first transatlantic balloon crossing—also unsuccessful.





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## REVIEWS & PREVIEWS

Capelotti is least readable when he inspects the archeological evidence of the reputed commercial tie-ins Wellman arranged for his journeys. But his descriptions of technology, equipment, and daily conditions are out of this world.

—*Nan Chase is a Boone, North Carolina-based freelance writer.*

## Duel for the Sky

by Christopher Shores. Grub Street, 1999. 208 pp., \$26.95 (paperback).

Christopher Shores is the dean of British aviation historians, working with nearly equal ease in the records of friendly and enemy air forces. But he's not an easy read. You fare best if you already know something of the campaign he's writing about.

In this handsome volume, Shores details 10 "crucial air battles" of World War II, beginning with the blitzkrieg that



destroyed the Polish air force in a week. He turns next to the Battle of Britain, in a short but exhaustive study of that most famous of all air campaigns. The text is enlivened by a campaign

map, photos, sketches of the competing aircraft and pilots, order-of-battle tables, and a dramatic painting by Terry Hadler.

Shores' choice of battles doesn't include all the obvious ones—Midway is absent, for example—but those highlighted are always interesting. The long and ultimately successful defense of Malta rates with the battle for Guadalcanal and the "Marianas turkey shoot," which broke the back of Japanese resistance in the Pacific. The Royal Air Force's night bombing of Germany gets equal time with the U.S. Army Air Force's day bombing campaign, and rightly so, but the equally interesting (and more destructive) B-29 raids on Japan are scarcely mentioned.

Rounding out Shores' selections are two that are unknown to most Americans: Desert Air Force operations against the Afrika Korps in Tunisia, and the air-to-mud battle in the Soviet Union's Kursk salient, where anti-tank aircraft like the Ilyushin Il-2 Shturmovik and the Henschel Hs-129B were as important as the fighter aircraft.

—*Daniel Ford is the author of Remains: A Story of the Flying Tigers.*

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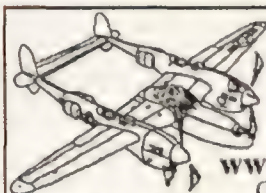
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## CALENDAR

### August 20

Vintage Aircraft Display and Midwest Antique Airplane Club Fly-In. Capitol Airport, Brookfield, WI, (262) 781-8132.

### August 26 & 27

Wings for Children: "Fly Around Town for Pennies a Pound." Allegheny County Airport, Pittsburgh, PA, (412) 469-9930.

### September 2-4

Cleveland National Air Show. Burke Lakefront Airport, Cleveland, OH, (216) 781-0747.

### September 4-10

National Stearman Fly-In. Galesburg, IL, (314) 283-7278.

### September 7-10

Reunion: Squadron VS 892. San Diego, CA. Contact John Walford, (619) 583-0656.

### September 8-10

Golden West EAA Regional Fly-In. Sacramento Executive Airport, Sacramento, CA, (530) 642-8063.

### September 9 & 10

MERFI-EAA Regional Fly-In. Municipal Airport, Marion, OH, (419) 447-1773.

Antique Airplane Club of Greater New York Fly-In. Brookhaven Airport, Brookhaven, NY, (631) 589-0374.

### September 16 & 17

North Central EAA Old Fashioned Fly-In. Whiteside County Airport, Rock Falls, IL, (630) 543-6743.

Potomac Fly-In (EAA Chapter 36). Potomac Airpark, Berkeley Springs, WV, (717) 294-3221.

### September 19-21

American Institute of Aeronautics and Astronautics Space 2000 Conference and Exhibition. Long Beach Convention Center, Long Beach, CA, (800) NEW-AIAA.

### September 23

Kolb Fly-In. Chesnut Knolls Airpark, London, KY, (606) 862-9692.

### September 23 & 24

Burlington International Charity Airshow. U.S. Air Force Thunderbirds will perform. Burlington, VT, (802) 496-8100.

### September 29-October 1

Dawn Patrol Rendezvous: World War I-Era Pageant. Wright Field, Dayton, OH, (937) 255-3286.

California International Airshow. Salinas Municipal Airport, Salinas, CA, 888-845-SHOW.

## CREDITS

**Under the Wire.** Dave Hirschman, a reporter at the *Atlanta Journal-Constitution*, is the co-author of *She's Just Another Navy Pilot* (Naval Institute Press, 2000).

**Heavy Duty.** William K. Kershner has been flying for 55 years and writes aviation textbooks published by Iowa State University Press.

**Back in the Race.** Carl Hoffman has written a book about hunting for military airplanes lost during World War II, including Darryl Greenamyer's attempt to recover the B-29 *Kee Bird*, which will be published by Ballantine Books next spring.

Phil Schofield is a freelance photographer working out of Bellingham, Washington. Although his adventurous spirit and work have taken him all over the world, he finds sailing the San Juan and Gulf Islands in his Tartan 30 the best adventure of all.

**Swarm.** Ben Iannotta is a freelance journalist and aspiring back-country fishing guide living in Key West, Florida.

John MacNeill was four years old when he started drawing rocket ships, and he's still doing it 30 years later (but usually not with crayons). His illustrations appear frequently in *Air & Space/Smithsonian*.

**Paris Envy.** Roger A. Mola, who was involved in finance and marketing until he discovered airplanes, follows and analyzes the airshow industry for the International Council of Air Shows and others.

**For Flying Out Loud.** Tom LeCompte is a freelance writer living in western Massachusetts. His own airplane is in dire need of a fresh coat of paint.

**First Up?** Tony Reichhardt is a contributing editor at *Air & Space*.

**Through the Lens of Ben Ross.** Chad Slattery (aeropix.com) has had 15 credits as a cover photographer for *Air & Space*; this is his first as a cover-story writer. He is based in Los Angeles.

**The Airplane Nobody Wanted.** One of former Air Force and Navy pilot Ralph Wetterhahn's combat squadrons had a motto: "Our mission is to fly and fight and don't you ever forget it." Turning his current sights on test flying and writing, the Long Beach, California resident now claims, "I fly and write and don't ever regret it!"



## ON THE WEB SITE

[www.airspacemag.com](http://www.airspacemag.com)

### Memories of the Korean War

The special "Korean War Album" section in the June/July 2000 issue evoked a lot of reader responses. We have published some of your letters in this issue, and also in a new feature on the Web site, "Community." We hope that outlet will encourage people to share stories about this unique era in American history. If you'd like to contribute to the memory bank, visit the Web site and look for "Memories of Korea."



## FORECAST

### In the Wings...



PHILIP MAKANNA

### Back From the Brink

Dedicated pilots and collectors are restoring the world's stock of P-40s, the shark-toothed fighters that America flew into World War II. The author, a former Tomahawk pilot, has mixed feelings about its comeback.

### Vietnam Memoir: Enemy Aces

A former U.S. Air Force F-4 pilot returns to Vietnam to find out what the war was like for the fighter pilots who were trying to kill him.

### The Other Jet Set

The high-pressure, low-profile world of private jet sales.

### Special Section: 100 Shuttle Missions

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**No Ordinary Airplane** High speed, no thrust, and the ground is racing toward you: A ride in NASA's Gulfstream II space shuttle simulator feels like the real thing.

**Go for Launch!** An *Air & Space/Smithsonian* guide to the best attractions not just at NASA's Kennedy Space Center but all along Florida's space coast.

**Bonus Poster** A study of the orbiter at work.

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# Cold Rush

A brand-new Fédération Aéronautique Internationale record category, Powered Paraglider Trikes, has its first entry: Bud Gish flew his Six-Chuter SR-2 to an altitude of 17,054 feet near Anchorage, Alaska, last April.

Gish was inspired to new heights after hearing about an unofficial altitude record of 15,450 feet made in a powered parachute. "I thought I might be able to top that," he says. Gish stripped his two-seat SR-2 of everything not required for safe flight. "I even put myself on a diet and lost 20 pounds," he says. After scaring up an oxygen supply and a barograph to verify altitude reached, Gish took off

from Birchwood airport on April 15. But at 12,000 feet, he ran afoul of an unforecast 50-mph west wind that threatened to carry him outside the flight corridor that Anchorage Approach Control had okayed for him. Just shy of 16,000 feet, he cut the 50-horsepower Rotax engine and glided back to the airport. That altitude would have been a

respectable record, but when he unpacked the barograph he found that it had conked out at 3,000 feet. No barograph verification, no record.

Figuring that the padding in the box he had designed to hold the barograph might have bound up the winding key, Gish reworked the box and tried again on April 27. This time, Anchorage Approach asked aircraft crossing its airspace about upper-level winds and gave Gish a real-time weather report. At 11 a.m. he took off.

At 15,000 feet the temperature was 20

below zero. As part of his weight reduction program, Gish had chosen the lightest clothing possible. "This proved to be very uncomfortable," he says. He was also getting light-headed. "I increased the flow rate on my oxygen and shivered on. The view of the Chugiak mountain range was spectacular. I could see across the mountains into Prince William Sound."

Gish's plan was to keep climbing until fuel was no longer visible in the sight tube, which would leave just enough for any delays in the landing pattern. "The last inch seemed to last an eternity as my feet quit hurting and went numb from

the cold," he says.

"I was still climbing around 30 feet per minute as the fuel finally dropped below the sight tube." Finally, he cut the engine and began the long glide down. At 12,000 feet the temperature began to rise, along with his spirits. At 3,000 feet he restarted the engine, and at 1:25 p.m. he was back down.

Did the barograph work? "As soon as we opened the box,

we heard it clanging away. What a sweet sound! It appeared that I had hit 17,200 feet." When all was said and done, the NAA notified Gish that his rise to 17,054 feet had earned him the U.S. national record in Class R, Microlights, Subclass R6, Powered Paraglider Trikes, Solo.



COURTESY BUD GISH

*Moments & Milestones is produced in association with the National Aeronautic Association. For information, visit the NAA Web site at [www.naa-usa.org](http://www.naa-usa.org).*

## LOGBOOK

### Awards

The 1999 NAA and U.S. Air Force Mackay Trophy will be presented to USAF Captain Jeffrey G.J. Hwang from the 493rd Fighter Squadron at Lakenheath Royal Air Force Base in England. Hwang made an exceptional F-15C combat flight in March 1999 during Operation Allied Force, in which he simultaneously destroyed two MiG-29s with AIM-120 missiles during a single intercept, while shooting beyond visual range in extremely constrained and volatile airspace.

### First Flights

Lockheed Martin's new Atlas III made its first launch on May 24 from the historic Complex 36 launch site at Florida's Cape Canaveral. The flight also marks the first time a Russian rocket engine was used to power a U.S. launch vehicle. The RD-180, which powered the Atlas booster flight phase, is the product of a joint venture between Pratt & Whitney and NPO Energomash. The Atlas III launch put a Eutelsat W4 communications satellite into orbit.

### Certificates

The Federal Aviation Administration granted certification to Worldwide Aeros for its Aeros 40B airship on June 23 at the company's hangar in San Bernardino, California. The 40B, an advertising-and-promotion/surveillance platform, is the seventh airship to receive FAA certification. (The first U.S. airship certification was issued to Goodyear in 1948.) Worldwide Aeros next plans a large passenger airship to carry sightseers.

### Call for Nominations

Nominations are due on August 15 for the 2000 Wright Brothers Memorial Trophy. Established in 1948, the trophy is presented annually to a living American for "significant public service of enduring value to aviation in the United States." The trophy will be presented in Washington, D.C., on December 15.



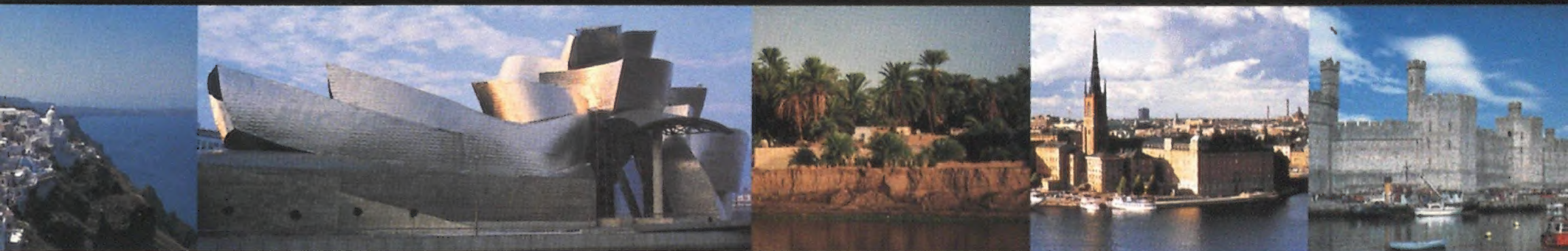


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aboard the *Yorktown Clipper*

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the *Seabourn Pride*

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(Washington, DC), November 10-14

Art and Spirit of Georgia O'Keeffe (Santa Fe),  
November 15-19

In Search of the Beautiful (Asilomar, CA),  
November 15-19

Civil War: Gettysburg, November 15-19 and  
November 29-December 3

New Astronomies: On the Threshold of a  
Millennium (Tucson), December 6-10

Van Gogh and French Portraiture  
(Philadelphia), December 7-11

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(Santa Fe), January 20-24

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March 21-25

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January 14-27

Undiscovered Belize: Walks in the Land of  
the Maya, January 20-28

Copper Canyon: Mexico's Sierra Madres,  
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